1 IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifier

Substance name: Magnesium
CAS name: Magnesium
IUPAC name: Magnesium
Chemical formula: Mg
Trade name: MAGNESIUM OR MAGNESIUM ALLOY POWDER
CAS: 7439-95-4
EINECS: 231-104-6
Molecular weight: 24.30 g/mol
REACH Registration number: 01-2119537203-49-0076

1.2 Relevant identified uses of the substance or mixture and uses advised against

1.2.1 Relevant identified uses

- Melting, alloying, casting (MAC)
- Particulates production & handling (PP&H)
- Fine particulates production (FPP)
- Metallurgical uses (MU)
- Solid forming processes (SFP) - incl. production of welding electrodes
- Corrosion protection (CP)
- Welding in industrial settings (W)
- Exposure during etching of magnesium dies
- Welding in professional settings (W)

Please refer to section 16 for a complete list of identified uses for which an exposure scenario is provided as an annex.

1.2.2 Uses advised against

There are no uses advised against.

1.3 Details of the supplier of the safety data sheet

Name: SFM SA (Société pour la Fabrication du Magnésium)
Address: Rue des Sablons 9
          1920 Martigny, Switzerland
Phone #: +41 (0) 27 721 75 90
Fax #: +41 (0) 27 721 75 95
E-mail of competent person responsible for SDS in the MS or in the EU: info@sfm-magnesium.ch
1.4 Emergency telephone number

European Emergency N°:  112
National centre for Prevention and Treatment of Intoxications N°:  145
Emergency telephone at the company  +41 (0) 27 721 88 88 (SOS Surveillance Company)
Available outside office hours:  Yes  No
Office hours:  24hrs

2 HAZARDS IDENTIFICATION

2.1 Classification of the substance

Remark: There are two entries in Regulation (EC) No 1272/2008 Annex VI existing for magnesium; one for magnesium powder (pyrophoric) and one for magnesium, powder or turnings, which are given below (section 2.1.1).

According to the current legal classification magnesium powder (pyrophoric) should be labelled as flammable in contact with air and magnesium, powder or turnings as auto-flammable.

The provider of this eSDS likes to note that this current legal classification does not reflect the long-time experience of the magnesium industry. Therefore, new studies have been conducted at BAM (Bundesanstalt für Materialforschung und –prüfung) in accordance to the current valid transport regulation “UN recommendations on transport of dangerous good, manual of tests and criteria, part III” which show that magnesium powder is neither flammable in contact with air nor auto-flammable. The classification as flammable in contact with water is dependent on the particle size distribution of magnesium powder. A proposed alternative C&L which based on high quality scientific data are given in section 16 of this eSDS including specific particle size (D50) cut off values.

Nevertheless, the current legal classification of magnesium according to Regulation (EC) No 1272/2008 Annex VI is obligatory until further notice of ECHA.

However, magnesium ingots (massive metal) are not classified in accordance to GHS.

2.1.1 Classification according to Regulation (EC) 1272/2008

Magnesium ingots (massive metal)
No classification

Magnesium powder (pyrophoric)
Pyrophoric solid Category 1
Substances and mixtures which in contact with water emit flammable gases Category 1

Magnesium, powder or turnings
Flammable solids Category 1
Self-heating substances and mixtures Category 1
Substances and mixtures which in contact with water emit flammable gases Category 2
2.1.2 Classification according to Directive 67/548/EEC

Magnesium ingots (massive metal)
No classification

Magnesium powder (pyrophoric)
F - Highly flammable

Magnesium, powder or turnings
F - Highly flammable

2.2 Label elements

2.2.1 Labelling according to Regulation (EC) 1272/2008

Magnesium ingots (massive metal)
No labelling needed

Magnesium powder (pyrophoric)

Signal word: Danger

Hazard pictogram:

GHS02

Hazard statements:
H250: Catches fire spontaneously if exposed to air
H260: In contact with water releases flammable gases which may ignite spontaneously

Precautionary statements:
P210: Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P223: Keep away from any possible contact with water, because of violent reaction and possible flash fire.
P240: Ground/bond container and receiving equipment.
Magnesium, powder or turnings

Signal word: Danger

Hazard pictogram:

GHS02

Hazard statements:
H228: Flammable solid.
H261: In contact with water releases flammable gases
H252: Self-heating in large quantities; may catch fire

Precautionary statements:
P210: Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P223: Keep away from any possible contact with water, because of violent reaction and possible flash fire.
P240: Ground/bond container and receiving equipment.

For labelling according to directive 67/548/EEC please refer to section 16.3 of this eSDS Harmonised labelling according to Directive 67/548/EEC

2.3 Other hazards

The substance does not meet the criteria for PBT or vPvB substance.
No other hazards identified

3 COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Main constituent
Name: Magnesium
CAS: 7439-95-4
EINECS: 231-104-6
REACH Registration number: 01-2119537203-49-(0076)\(^1\)

Purity: ca. 99.5 % (w/w)

Impurities
No impurities relevant for classification and labelling.

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\(^1\) According to commission regulation (EC) No 453/2010 section 1.1: “Without affecting the obligations of downstream users laid down in Article 39 of this Regulation, the part of the registration number referring to the individual registrant of a joint submission (Authors note: the last four digits) may be omitted by a supplier who is a distributor or a downstream user...”
4 FIRST AID MEASURES

4.1 Description of first aid measures

**Magnesium powders**

**General advice**
No special advice must be considered.

**Following inhalation**
In the event of dust inhalation; Remove victim to fresh air and keep at rest in a position comfortable for breathing.

**Following ingestion**
Call a POISON CENTER or doctor/physician if you feel unwell.

**Following skin contact**
IF ON SKIN: Wash with of soap and water.

**Following eye contact**
Contact with eyes: In case of penetration of dust or small turnings; rinse cautiously with water for several minutes, if eye irritation persists: Get medical advice/attention.

**Magnesium ingots (massive metal)**

**General advice**
No special advice must be considered.

**Following ingestion**
Call a POISON CENTER or doctor/physician if you feel unwell.

**Following eye contact**
Contact with eyes: If eye irritation persists: Get medical advice/attention.

4.2 Most important symptoms and effects, both acute and delayed

Diarrhoea.

4.3 Indication of any immediate medical attention and special treatment needed

Advises are given in section 4.1; No special treatment needed.

5 FIRE FIGHTING MEASURES

5.1 Extinguishing media

5.1.1 Suitable extinguishing media

Use dry extinguishing materials (e.g. dry sand, fluxes, iron chips, cement, class D fire extinguisher).

5.1.2 Unsuitable extinguishing media

Do not use water.
5.2  Special hazards arising from the substance or mixture

Risk of dust ignition/explosion exists.
Avoid formation of dust also in case of handling massive objects.

5.3  Advice for fire fighters

Avoid contact with water. Use dry extinguishing materials (e.g. dry sand, fluxes, iron chips, cement, class D fire extinguisher).

6  ACCIDENTAL RELEASE MEASURES

6.1  Personal precautions, protective equipment and emergency procedures

6.1.1  For non-emergency personnel

Keep away from any possible contact with water, because of violent reaction and possible flash fire. Brush off lose particles from skin.

6.1.2  For emergency responders

Advises are given in section 6.1.1.

6.2  Environmental precautions

No special precautions must be considered. Magnesium is abundantly present in all environmental compartments.

6.3  Methods and material for containment and cleaning up

Avoid dust formation. Pick up the product mechanically in a dry way. Magnesium waste should be recycled as much as possible.

6.4  Reference to other sections

For more information on exposure controls/personal protection or disposal considerations, please check section 7, 8 and 13 and the Annex of this safety data sheet.

7  HANDLING AND STORAGE

7.1  Precautions for safe handling

7.1.1  Protective measures

Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting.
Store in a dry place.
Store in a closed container.

Advice on general occupational hygiene

No smoking, due to the highly flammable potential of powders. If small parts are on skin, wash with plenty of water.
7.2 Conditions for safe storage, including any incompatibilities

General

Keep away from heat/sparks/open flames/hot surfaces. No smoking. Keep away from any possible contact with water. Avoid dust formation.

Magnesium powders

Store in a dry place.
Store in a closed container.
Ground bond container
Avoid generation of condensed water due to harsh temperature changes in-between different storages/stocks or as a consequence of thermal difference between transportation and storage conditions.

Magnesium ingots (massive metal)

Store in a dry place.
Avoid generation of condensed water (outer and inner surfaces of ingot) due to harsh temperature changes in-between different storages/stocks or as a consequence of thermal difference between transportation and storage conditions.

7.3 Specific end use(s)

Please check the identified uses in Section 16 and Annex of this eSDS. For more information please see relevant exposure scenario (Annex to this SDS) or contact supplier.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

PNEC value (dissolved magnesium) for European Union/Member state, based on added Mg concentrations

<table>
<thead>
<tr>
<th>Country</th>
<th>Freshwater mg Mg/l</th>
<th>Marine water mg Mg/l</th>
<th>Freshwater, intermittent releases mg Mg/l</th>
<th>STP mg Mg/l</th>
<th>Freshwater sediment mg Mg/kg dw</th>
<th>Marine sediment mg Mg/kg dw</th>
<th>Soil mg Mg/kg dw</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNECadded (Predicted No Effect Concentration)</td>
<td>0.41</td>
<td>0.41</td>
<td>1.4</td>
<td>=10.8</td>
<td>268</td>
<td>268</td>
<td>268</td>
</tr>
<tr>
<td>Typical natural background concentration</td>
<td>7.1</td>
<td>1290</td>
<td>7.1</td>
<td>No data</td>
<td>6918</td>
<td>No data</td>
<td>3930</td>
</tr>
</tbody>
</table>

All PNEC values are based on added magnesium concentrations (PNECadded), without taking into account the natural background in the exposure media. The PNECtotal can be calculated as the sum of PNECadded and the background concentration for Mg in the corresponding environmental compartment.

DNELs for workers

Magnesium is a non-soluble inert powder with an MMAD of 25.6 µm and GSD of 1.72 µm, and the derived DNEL for inhalation is above 10 mg/m3 for the inhalable airborne fraction which is the general dust limit for the
inhalable airborne fraction. Therefore, this general dust limit will be applied for exposure scenarios with exposure to magnesium oxide dust.

**DNELs for general population**

Magnesium is a non-soluble inert powder with an MMAD of 25.6 µm and GSD of 1.72 µm, and the derived DNEL for inhalation is above 10 mg/m³ for the inhalable airborne fraction which is the general dust limit for the inhalable airborne fraction. Therefore, this general dust limit will be applied for exposure scenarios with exposure to magnesium oxide dust.

8.2 Exposure controls

No special exposure controls. In case of handling magnesium powder please refer to the respective eSDS.

8.2.1 Appropriate engineering controls

Not applicable

8.2.2 Individual protection measures, such as personal protective equipment

Please refer to section 7. In case of handling magnesium powder please refer to the respective eSDS.

8.2.3 Environmental exposure controls

Please refer to the Annex – exposure scenarios

9 PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a. Appearance: Silvery-white metal (solid) at room temperature and under atmospheric pressure; Form is powder (handbook data) or ingot
b. Odour: odourless (handbook data)
c. Odour threshold: not applicable
d. pH: not applicable
e. Melting point: 650°C (handbook data)
f. Boiling point: ca. 1095°C (handbook data)
g. Flash point: not applicable (inorganic solid)
h. Evaporation rate: not applicable (inorganic solid with a melting point at 650°C)
i. Flammability (solid): highly flammable as powder (study result, EU method A.10)
j. Explosive limits: non-explosive (the substance is void of any chemical structures commonly associated with explosive properties)
k. Vapour pressure: not applicable (solid with a melting point at 650°C)
l. Vapour density: not applicable
m. Relative density: 1.76 (23°C) (study result, OECD 109)
n. Solubility in water: 6.7 mg/L (21°C, pH ca. 10.8) (study result, EU method A.6, OECD 105)
o. Partition coefficient: not applicable (inorganic substance)
p. Auto ignition temperature: not self-heating substance (study result, UN-Test N.4)
q. Decomposition temperature: not applicable
r. Viscosity: not applicable (solid with a melting point at 650°C)
s. Explosive properties: non-explosive (the substance is void of any chemical structures commonly associated with explosive properties)
t. Oxidising properties: no oxidising properties (substance does not contain a surplus of oxygen or any structural groups known to be correlated with a tendency to react exothermally with combustible material)

9.2 Other information

The substance is legally classified as being self-heating (magnesium powder or turnings) and to be flammable in contact with air (magnesium powder (pyrophoric)), respectively according to Regulation (EC) 1272/2008 Annex VI.

The provider of this eSDS likes to note that this current legal classification does not reflect the long-time experience of the magnesium industry. Therefore, new studies have been conducted at BAM (Bundesanstalt für Materialforschung und –prüfung) in accordance to the current valid transport regulation “UN recommendations on transport of dangerous good, manual of tests and criteria, part III” which show that magnesium powder is neither flammable in contact with air nor auto-flammable (measured for magnesium powder samples up to a particle size of \(D_{50} 40 \mu m\)).

Nevertheless, the current legal classification of magnesium according to Regulation (EC) No 1272/2008 Annex VI is obligatory until further notice of ECHA.

However, magnesium ingots (massive metal) are not classified in accordance to GHS.

10 STABILITY AND REACTIVITY

10.1 Reactivity

In the course of hydrolysis slowly releases flammable/explosive hydrogen gas. Generation rate is greatly increased with smaller particles.

10.2 Chemical stability

Under normal conditions of use and storage (closed in original container and under dry conditions) magnesium is stable.

10.3 Possibility of hazardous reactions

See point 10.1 “Reactivity”

10.4 Conditions to avoid

Keep away from any possible contact with water. Avoid generation of condensed water.

10.5 Incompatible materials

Water
10.6 Hazardous decomposition products

In contact with water hydrogen is formed which is a highly flammable gas.

11 TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

The information provided in this section is consistent with the information provided in the REACH chemical safety report (CSR) for magnesium. During development of the CSR all available toxicological data have been considered and evaluated for relevance and reliability. Non-reliable data have not been considered in the assessment.

<table>
<thead>
<tr>
<th>Toxicity endpoints</th>
<th>Outcome of the effects assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. Acute toxicity</strong></td>
<td>Magnesium powder is not acutely toxic via the oral, dermal, or inhalation route.</td>
</tr>
<tr>
<td><strong>Oral, rat, gavage</strong></td>
<td><em>(Read-across - MgCl$_2$ * 6H$_2$O)</em></td>
</tr>
<tr>
<td><strong>LD$_{50}$ &gt; 2000 mg/kg bw (OECD 423)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Dermal</strong></td>
<td>Following the HERAG guidance for metals and metal salts, a dermal absorption rate in the range of maximally 0.1-1.0 % can be anticipated. Dermal absorption in this order of magnitude is not considered to be “significant”.</td>
</tr>
<tr>
<td><strong>Inhalation:</strong></td>
<td><em>(Read-across - MgO)</em></td>
</tr>
<tr>
<td><strong>No acute inhalation toxicity. Exposure to respirable MgO did not produce any measurable pulmonary inflammation.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>b. Skin corrosion / irritation</strong></td>
<td>Based on available data, the classification criteria for skin irritation are not met.</td>
</tr>
<tr>
<td><em>(Read across - MgCl$_2$ hexahydrate)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Skin irritation: not irritating (in vitro study, equivalent or similar to EU method B.46, reconstructed human epidermis)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>c. Serious eye damage / irritation</strong></td>
<td>Based on available data, the classification criteria for eye irritation are not met.</td>
</tr>
<tr>
<td><em>(Read across - MgCl$_2$ hexahydrate)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Eye irritation: not irritating (OECD 405, rabbit)</strong></td>
<td></td>
</tr>
</tbody>
</table>
**Toxicity endpoints** | **Outcome of the effects assessment**
--- | ---
**d. Respiratory or skin sensitisation** | Based on available data, the classification criteria for sensitisation are not met.  
(Read across - magnesium alloys (with a total magnesium content between 89.2 – 96.8%).)  
Skin sensitisation: not sensitising (OECD 406, GMPT)
**e. Germ cell mutagenicity** | Based on available data, the classification criteria for mutagenicity are not met. Read across to various magnesium substances.  
(i) Bacterial reverse mutation assay (S.typhimurium, E.coli): (Ames test; OECD 471) **negative**  
(ii) Gene mutation (OECD 476, mouse lymphoma): **negative**  
(iii) *in vitro* mammalian chromosome aberration test (Chinese hamster lung fibroblast cell line) (OECD 473): **negative**
**f. Carcinogenicity** | Based on available data, the classification criteria for carcinogenicity are not met.  
(Read across - MgCl₂ hexahydrate)  
oral, mice, 96 weeks  
No evidence of a carcinogenic potential was found
**g. Reproductive toxicity** | Based on available data, the classification criteria for reproductive toxicity are not met.  
Data published by the opinion of the Scientific Committee on Food, 2001 stated a lack of effects during the intake of high amounts of magnesium on the reproductive function in humans. The information are sufficient for risk characterisation.
**h. STOT-single exposure** | Based on available data, the classification criteria for STOT-single exposure are not met.  
The classification criteria according to regulation (EC) 1272/2008 as specific target organ toxicant (STOT) – single exposure, oral, inhalation are not met since no reversible or irreversible adverse health effects were observed immediately or delayed after exposure.
**i. STOT-repeated exposure** | Based on available data, the classification criteria for STOT-repeated exposure are not met.  
The only effect observed is that magnesium causes diarrhoea if ingested in high doses. According to the scientific committee on food, 2001 it can be assumed that the no-effect level of daily magnesium intake is 250 mg/day. It is explicitly note that this value does not include Mg normally present in foods and beverages. This effect could be regarded as non "significant" or non "severe", and does not indicate functional disturbance or morphological changes of toxicological relevance.
Toxicity endpoints

<table>
<thead>
<tr>
<th>j. Aspiration hazard</th>
<th>Outcome of the effects assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No hazard expected.</td>
</tr>
</tbody>
</table>

Further remarks

<table>
<thead>
<tr>
<th>Summary CMR effects</th>
<th>Magnesium does not fulfil the criteria for CMR (carcinogen, mutagen, toxic to reproduction) Cat. 1 and Cat. 2 according to regulation (EC) 1272/2008.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information on the likely route of exposure</td>
<td>The primary routes of human exposure to magnesium are from inhalation of aerosols and ingestion of food and drinking water containing magnesium.</td>
</tr>
</tbody>
</table>

12 ECOLOGICAL INFORMATION

12.1 Toxicity

12.1.1 Acute toxicity

No data are available on ecotoxicity of Mg metal. Read-across from MgSO₄ and MgCl₂ (and their hydrated forms).

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>End-point</th>
<th>Value</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater fish: <em>Pimephales promelas</em></td>
<td>96h-LC₅₀</td>
<td>541 mg Mg/l</td>
<td>Mount et al. 1997</td>
</tr>
<tr>
<td>Freshwater invertebrates: <em>Daphnia magna</em></td>
<td>48h-LC₅₀</td>
<td>140 mg Mg/l</td>
<td>Pillard et al. 2000</td>
</tr>
<tr>
<td>Freshwater algae: <em>Scenedesmus subspicatus</em></td>
<td>72h-ErC₅₀ (growth rate)</td>
<td>&gt;12 mg Mg/l</td>
<td>Biesinger and Christensen 1972</td>
</tr>
<tr>
<td>Marine fish: <em>Menidia beryllina</em></td>
<td>48h-LC₅₀</td>
<td>2800 mg Mg/l</td>
<td>Dengler 2010a</td>
</tr>
<tr>
<td>Marine invertebrates: <em>Mysidopsis bahia</em></td>
<td>48h-LC₅₀</td>
<td>2650 mg Mg/l</td>
<td>Dengler 2010a</td>
</tr>
</tbody>
</table>

All tests were conducted according to international test guidelines (e.g., OECD) or scientifically acceptable methods.
12.1.2 Chronic toxicity

No data are available on ecotoxicity of Mg metal. Read-across from MgSO₄ and MgCl₂ (and their hydrated forms).

<table>
<thead>
<tr>
<th>Test organisms</th>
<th>End-point</th>
<th>Value</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater invertebrates: Daphnia magna</td>
<td>21-day EC&lt;sub&gt;10&lt;/sub&gt; for reproduction</td>
<td>82 mg Mg/l</td>
<td>Pillard et al. 2000</td>
</tr>
<tr>
<td>Freshwater algae: Scenedesmus subspicatus</td>
<td>72h-NOEC for growth rate</td>
<td>=12 mg Mg/l</td>
<td>Biesinger and Christensen 1972</td>
</tr>
</tbody>
</table>

No reliable data are available for chronic toxicity of Mg to fish. According to the available toxicity data for aquatic organisms, there is no need for classification of Mg as dangerous to the aquatic environment, and based on the acute toxicity data, fish are less sensitive compared to aquatic invertebrates. The low toxic potential of Mg to aquatic organisms is also illustrated by the fact that Mg is a major essential element for aquatic organisms and that Mg is abundantly present in the aquatic environment with typical natural background concentrations of 7.1 mg Mg/l and 1290 mg Mg/l for freshwater and marine water, respectively.

Chronic sediment toxicity

No reliable data are available for the acute or chronic toxicity of magnesium to sediment organisms. PNEC derivation was based on the equilibrium partitioning method, taking into account the PNEC for freshwater or marine water and the sediment Kd-value given in section 12.4.

Chronic terrestrial toxicity

No reliable data are available for the acute or chronic toxicity of magnesium to soil organisms. PNEC derivation was based on the equilibrium partitioning method, taking into account the PNEC for freshwater and the sediment Kd-value given in section 12.4.

All tests were conducted according to international test guidelines (e.g., OECD) or scientifically acceptable methods.

12.1.3 Toxicity to micro-organisms e.g. bacteria

No data are available on toxicity of Mg metal. Read-across from MgCl₂ hexahydrate.

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>End-point</th>
<th>Value</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic activated sludge population</td>
<td>3h-EC&lt;sub&gt;10&lt;/sub&gt; for respiration inhibition (according to OECD 209)</td>
<td>=108 mg Mg/l</td>
<td>Dengler 2010b</td>
</tr>
</tbody>
</table>

12.1.4 Toxicity to birds

There is no potential for bioaccumulation and no risk of secondary poisoning for magnesium below the PNEC for direct toxicity in the various environmental compartments.

12.1.5 Conclusion on environmental classification and labelling

Magnesium is not hazardous to the aquatic environment as:
- The lowest acute reference values for fish, invertebrates and algae are > 100 mg Mg/l.
- The lowest aquatic NOEC for these three trophic levels is > 1 mg Mg/l (i.e., 41 mg Mg/l for Daphnia magna; no data are available for fish but based on the acute toxicity data, fish are less sensitive compared to aquatic invertebrates).
- There is no evidence for bioaccumulation or biomagnification in the environment.
12.2 Persistence and degradability

Magnesium is naturally occurring and ubiquitous in the environment. Upon contact with water, magnesium metal dissolves and behaves as magnesium naturally present in the environment. Biodegradation is not relevant for Mg metal, which is considered as not biodegradable.

12.3 Bioaccumulative potential

Bioaccumulation of magnesium in aquatic/terrestrial organisms is considered to be of no concern since magnesium is an essential element for aquatic and terrestrial organisms. The uptake of essential elements is generally under strict homeostatic control. Under these conditions, the internal concentration of these elements is maintained over a wide concentration range in the environment and rises only dramatically under conditions that are toxic for aquatic and terrestrial organisms.

12.4 Mobility in sediment and soil

Magnesium metal is soluble in water. A log Kd value of 2.82 l/kg dw has been determined for freshwater sediment and no data are available for soil. Based on this relatively low Kd value, the Mg$^{2+}$ ions can leach through normal soil and are relatively mobile in sediment. Results of PBT and vPvB assessment

12.5 Other adverse effects

No other adverse effects are identified.

13 DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Recommendation: Disposal must be made according to official regulations.

14 TRANSPORT INFORMATION

The following information is valid for magnesium powder. For magnesium massive metal there is no special transport information needed. The transport regulation for magnesium powder is given in the following:

14.1 UN-Number

UN 1418  Magnesium or Magnesium alloy powder
UN 1869  Magnesium granules or Magnesium turnings

14.2 UN proper shipping name

Magnesium powder or Magnesium alloys powder (UN 1418)
Magnesium granules or Magnesium turnings (UN 1869)
14.3 Transport hazard class(es)

**UN 1418**  
Magnesium or Magnesium alloy powder

ADR/RID: Class 4.3 Substances which, in contact with water, emit flammable gases  
AND(R): Class 4.3 Substances which, in contact with water, emit flammable gases  
IMDG: Class 4.3 Substances which, in contact with water, emit flammable gases  
EmS number: 43-06  
ICAO/IATA: Class 4.3 Substances which, in contact with water, emit flammable gases

**UN 1869**  
Magnesium granules or Magnesium turnings

ADR/RID: Class 4.1 Substances which, in contact with water, emit flammable gases  
AND(R): Class 4.1 Substances which, in contact with water, emit flammable gases  
IMDG: Class 4.1 Substances which, in contact with water, emit flammable gases  
EmS number: 4.1-02  
ICAO/IATA: Class 4.1 Substances which, in contact with water, emit flammable gases

14.4 Packing group

**UN 1418**  
Magnesium or Magnesium alloy powder

Group I (ADR/RID, AND(R), IMDG, ICAO/IATA)  
Group II (ADR/RID, AND(R), IMDG, ICAO/IATA)  
Group III (ADR/RID, AND(R), IMDG, ICAO/IATA)

**UN 1869**  
Magnesium granules or Magnesium turnings

Group III (ADR/RID, AND(R), IMDG, ICAO/IATA)

14.5 Environmental hazards

IMDG: no marine pollutant

14.6 Special precautions for user

None

14.7 Transport in bulk according to Annex II of MARPOL.73/78 and the IBC Code

Not regulated.
15 REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance

Authorisation: Unknown
Restrictions on use: Unknown
Other EU regulations: Unknown
National regulations: Unknown
Restrictions of occupation: Unknown

15.2 Chemical safety assessment

A chemical safety assessment has been carried out for this substance and is provided within the technical dossier, submitted to ECHA in October 2010.

16 OTHER INFORMATION

16.1 General

Data are based on our latest knowledge but do not constitute a guarantee for any product features and do not establish a legally valid contractual relationship.

16.2 Proposed alternative classification and labelling

16.2.1 Proposed alternative classification according to Regulation (EC) No 1272/2008 [CLP/GHS]

Remarks: The current legal classification of magnesium according to Regulation (EC) No 1272/2008 Annex VI is obligatory until further notice of ECHA.

Magnesium ingots (massive metal)

Not classified

Magnesium powder (D50 = 122 µm)
Flammable solids Category 1
Water React. Flam. Gas 2

Magnesium powder (D50 = 123 µm - = 1900 µm)
Flammable solids Category 1
Water React. Flam. Gas 3

Magnesium powder (D50 = 1900 µm, D1 >500 µm) ¹¹
Flammable solids Category 1

¹¹ For powders with a D50 value >500 µm this classification only applies if the powder consists of less than 1% (mass) of particles <500 µm diameter. According to UN Recommendations on the Transport of Dangerous...
Good, Manual of Tests and Criteria, the test material should be ground to a powder if the mass of this powder (<500 µm) is >1%.

16.2.2 Proposed alternative classification according to Directive 67/548/EEC

Magnesium ingots (massive metal)
Not classified

Magnesium powder
F – Highly flammable

16.2.3 Proposed alternative labelling according to Regulation (EC) No 1272/2008 [CLP/GHS]

Note: Please also refer to the remarks under Section 16.2.1

Magnesium ingots (massive metal)
No labeling needed
Magnesium powder (D50 = 122 μm)

Signal word: Danger

Hazard pictogram

GHS02

Hazard statement

H228: Flammable solid.
H261: In contact with water releases flammable gases.

Magnesium powder (D50 = 123 μm - = 1900 μm)

Signal word: Danger

Hazard pictogram

GHS02

Hazard statement

H228: Flammable solid.
H261: In contact with water releases flammable gases.

Magnesium powder (D50 = 1900 μm, D1 >500 μm)

Signal word: Danger

Hazard pictogram

GHS02
Hazard statement

H228: Flammable solid.

16.2.4 Proposed alternative labelling according to Directive 67/548/EEC

Magnesium ingots (massive metal)

No labeling needed

Magnesium powder (D_{50} = 1900\mu m)

Risk phrase:

R11 - highly flammable
R15 - contact with water liberates extremely flammable gases

Safety phrases

S2 - keep out of the reach of children
S7/8 - keep container tightly closed and dry
S43 - in case of fire, use dry sand, fluxes, iron chips, cement, class D fire extinguisher. Never use water.

Magnesium powder (D_{50} > 1900\mu m, D_1 >500 \mu m)

Risk phrase:

R11 - highly flammable

Safety phrases

S2 - keep out of the reach of children
S7/8 - keep container tightly closed and dry

16.3 Harmonised labelling according to Directive 67/548/EEC

Magnesium ingots (massive metal)

No entry

Magnesium powder (pyrophoric)

Risk phrases:

R15 - contact with water liberates extremely flammable gases
R17 - spontaneously flammable in air
Safety phrases:
S2 - keep out of the reach of children
S7/8 - keep container tightly closed and dry
S43 - in case of fire, use dry sand. Never use water

Magnesium, powder or turnings

Risk phrases:
R11 - highly flammable
R15 - contact with water liberates extremely flammable gases

Safety phrases:
S2 - keep out of the reach of children
S7/8 - keep container tightly closed and dry
S43 - in case of fire, use dry sand. Never use water

16.4 Abbreviations

(NOT ALL ARE USED IN THIS SDS)
AC Article category
ADR European agreement concerning the international carriage of dangerous goods by road
AND European agreement concerning the international carriage of dangerous goods by inland waterways
BSAF Bio soil accumulation factor
BCF Bio concentration factor
CAS Chemical Abstracts Service
CLP Classification, labelling and packaging
CMR Carcinogenic, mutagenic or toxic for reproduction
CSA/CSR Chemical safety assessment / Chemical safety report
D₅₀ Median particle size
DNEL Derived no effect level
DSD Dangerous Substance Directive
EC₁₀ Concentration of a substance where 10% of the population is affected
EC₅₀ Concentration of a substance where 50% of the population is affected
ECHA European chemicals agency
EINECS EU list of existing chemical substances
EmS Emergency schedule
ERC Environmental release category
ES Exposure scenario
eSDS Extended safety data sheet
FOREGS Forum of European Geological Surveys
GHS Globally harmonised system
HERAG Health risk assessment guidance for metals
IATA-DGR International air transport association - dangerous goods regulations
ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air
IU Identified use
IUPAC International Union of Pure and Applied Chemistry
IBC code International code for the construction and equipment of ships carrying dangerous chemicals in bulk
IMDG International maritime dangerous goods
Kp  Partition coefficient
LC10  Lethal concentration of a substance that can be expected to cause death in 10% of the population
LC50  Lethal concentration of a substance that can be expected to cause death in 50% of the population
LD50  Lethal dose of a substance that can be expected to cause death in 50% of the population
MARPOL 73/78  International convention for the prevention of pollution from ships, 1973 as modified by the protocol of 1978
MMAD  Mass median aerodynamic diameter
NO(A)EC  No observed (adverse) effect concentration
NO(A)EL  No observed (adverse) effect level
OECD  Organisation for economic co-operation and development
OEL  Occupational exposure limit
PBT  Persistent, bioaccumulative, and toxic
PC  Product category
PNEC  Predicted no-effect concentration
PROC  Process category
REACH  Registration, evaluation, authorisation and restriction of chemicals (i.e. Regulation (EC) No. 1907/2006)
RID  International rule for transport of dangerous substances by railway
SDS  Safety data sheet
STOT  Specific target organ toxicant
STP  Sewage treatment plant
SU  Sector of end use
TWA  Time weighted average
vPvB  Very persistent, very bioaccumulative

16.5  Key literature references

The information provided in this eSDS is consistent with the information provided in the REACH chemical safety report (CSR) for magnesium. The CSR contains a complete reference list for all data used. Non-confidential data from the REACH registration dossier is published by the European Chemicals Agency ECHA, see http://apps.echa.europa.eu/registered/registered-sub.aspx.

16.6  Revision

This is the first version of the eSDS of magnesium. Hence, no revision information should be mentioned here.

Disclaimer

MaREC provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. Furthermore, this safety data sheet is made up based on the legal requirements as set by EC 1907/2006 (REACH) based on information as is available per November 2010.

16.7  Identified uses

To demonstrate the safe use of magnesium, occupational exposure scenarios (attached to this e-SDS; Annex) have been developed to serve as generic scenarios based on the degree of dustiness of the handled substance. Each scenario includes all processes related to the production and the reported identified uses of magnesium.
Each scenario includes the exposure assessment and risk characterisation of occupational/worker exposure, the occupational exposure of downstream users and references to the environmental exposure scenarios.
## Overview table of identified uses:

### (a) Formulation

<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting, alloying, casting (MAC)</td>
<td>Foundry industry: ES 1</td>
<td><strong>Environmental release category (ERC):</strong></td>
<td>Substance supplied to that use:</td>
</tr>
<tr>
<td></td>
<td>Particulate production (Mg compound): ES 2</td>
<td>ERC 1: Manufacture of substances</td>
<td>As such</td>
</tr>
<tr>
<td></td>
<td>Alloys formulation: ES 3</td>
<td>ERC 2: Formulation of preparations</td>
<td>In a mixture</td>
</tr>
<tr>
<td></td>
<td>Particulate production (Mg metal): ES 5</td>
<td>ERC 3: Formulation in materials</td>
<td>Remarks:</td>
</tr>
<tr>
<td></td>
<td>Metallurgical industry: ES 6</td>
<td>ERC 4: Industrial use of processing aids in processes and products, not becoming</td>
<td>Depending on product requirements, magnesium helps to improve strength, luminance,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>part of articles</td>
<td>and weight.</td>
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<tr>
<td></td>
<td></td>
<td>ERC 5: Industrial use resulting in inclusion into or onto a matrix</td>
<td>As a component in alloys and used in electronic devices, magnesium helps to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ERC 12a: Industrial processing of articles with abrasive techniques (low release)</td>
<td>decrease the weight and to increase the strength.</td>
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<td><strong>Process category (PROC):</strong></td>
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<td>PROC 2: Use in closed, continuous process with occasional controlled exposure</td>
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<td>PROC 3: Use in closed batch process (synthesis or formulation)</td>
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<td>PROC 21: Low energy manipulation of substances bound in materials and/or articles</td>
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<td>PROC 22: Potentially closed processing operations with minerals/metals at</td>
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<td>elevated temperature. Industrial setting</td>
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<td>PROC 23: Open processing and transfer operations with minerals/metals at</td>
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<td>elevated temperature.</td>
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<td>PROC 24: High (mechanical) energy work-up of substances bound in</td>
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<td>materials and/or articles</td>
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<td>PROC 25: Other hot work operations with metals</td>
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<td>PROC 26: Handling of solid inorganic substances at ambient temperature</td>
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<td><strong>Product Category formulated:</strong></td>
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<td>PC 7: Base metals and alloys</td>
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<td>Identifiers</td>
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<td>Other information</td>
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<td>Particulates production &amp; handling (PP&amp;H)</td>
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<td>Chemical application:</td>
<td>Environmental release category (ERC):</td>
<td>Substance supplied to that use:</td>
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<td></td>
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<td>Other industrial application</td>
<td>Process category (PROC):</td>
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<td>ES 6</td>
<td>PROC 1: Use in closed process, no likelihood of exposure</td>
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<td>PROC 3: Use in closed batch process (synthesis or formulation)</td>
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<td>PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</td>
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<td>Product Category formulated:</td>
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<td>PC 3: Air care products</td>
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<td>PC 7: Base metals and alloys</td>
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<td>PC 19: Intermediate</td>
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<td>PC 0: Other: pyrotechnic composition</td>
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<td>Technical function of the substance during formulation:</td>
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<td></td>
<td></td>
<td>Several functions</td>
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</tbody>
</table>

Technical function of the substance during formulation: Several functions.
<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine particulates production (FPP)</td>
<td>Particulates production: ES 3</td>
<td><strong>Environmental release category (ERC):</strong>&lt;br&gt;ERC 2: Formulation of preparations&lt;br&gt;ERC 3: Formulation in materials&lt;br&gt;ERC 5: Industrial use resulting in inclusion into or onto a matrix&lt;br&gt;ERC 8e: Wide dispersive outdoor use of reactive substances in open systems&lt;br&gt;ERC 12a: Industrial processing of articles with abrasive techniques (low release)&lt;br&gt;&lt;br&gt;<strong>Process category (PROC):</strong>&lt;br&gt;PROC 3: Use in closed batch process (synthesis or formulation)&lt;br&gt;PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises&lt;br&gt;PROC 7: Industrial spraying&lt;br&gt;PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities&lt;br&gt;PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities&lt;br&gt;PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)&lt;br&gt;PROC 10: Roller application or brushing&lt;br&gt;PROC 13: Treatment of articles by dipping and pouring&lt;br&gt;PROC 14: Production of preparations or articles by tableting, compression, extrusion, pelletisation&lt;br&gt;PROC 19: Hand-mixing with intimate contact and only PPE available.&lt;br&gt;PROC 21: Low energy manipulation of substances bound in materials and/or articles&lt;br&gt;PROC 22: Potentially closed processing operations with</td>
<td>Substance supplied to that use:&lt;br&gt;As such&lt;br&gt;In a mixture&lt;br&gt;Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight.&lt;br&gt;As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
</tbody>
</table>
### Identifiers
- Relevant exposure Scenarios
- Use descriptors
- Other information

<table>
<thead>
<tr>
<th>Minerals/metals at elevated temperature. Industrial setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature</td>
</tr>
<tr>
<td>PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles</td>
</tr>
<tr>
<td>PROC 26: Handling of solid inorganic substances at ambient temperature</td>
</tr>
</tbody>
</table>

**Product Category formulated:**
- PC 7: Base metals and alloys
- PC 0: Other: pyrotechnic composition

**Technical function of the substance during formulation:**
- Several functions

### Uses at industrial sites

<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
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<tr>
<td>Alloys formulation: <strong>ES 3</strong></td>
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<tr>
<td>Particulate production (Mg metal): <strong>ES 5</strong></td>
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<tr>
<td>Metallurgical industry: <strong>ES 6</strong></td>
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<tr>
<td>Environmental release category (ERC):</td>
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<tr>
<td>ERC 1: Manufacture of substances</td>
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<tr>
<td>ERC 4: Industrial use of processing aids in processes and products, not becoming part of articles</td>
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<tr>
<td>ERC 5: Industrial use resulting in inclusion into or onto a matrix</td>
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<tr>
<td>ERC 12a: Industrial processing of articles with abrasive techniques (low release)</td>
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<tr>
<td>Process category (PROC):</td>
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<tr>
<td>PROC 2: Use in closed, continuous process with occasional controlled exposure</td>
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<tr>
<td>PROC 3: Use in closed batch process (synthesis or</td>
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</tbody>
</table>

**Remarks:**
- Depending on product requirements, magnesium helps to improve strenght, luminance, and weight.
## Identifiers

<table>
<thead>
<tr>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROC 21: Low energy manipulation of substances bound in materials and/or articles</td>
<td>formulation</td>
<td>As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
<tr>
<td>PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting</td>
<td>PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature</td>
<td></td>
</tr>
<tr>
<td>PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles</td>
<td>PROC 25: Other hot work operations with metals</td>
<td></td>
</tr>
<tr>
<td>PROC 26: Handling of solid inorganic substances at ambient temperature</td>
<td>Product Category used:</td>
<td></td>
</tr>
<tr>
<td>PC 7: Base metals and alloys</td>
<td>Sector of end use:</td>
<td></td>
</tr>
<tr>
<td>SU 14: Manufacture of basic metals, including alloys</td>
<td>Environmental release category (ERC):</td>
<td></td>
</tr>
<tr>
<td>SU 15: Manufacture of fabricated metal products, except machinery and equipment</td>
<td>ERC 2: Formulation of preparations</td>
<td></td>
</tr>
<tr>
<td>SU 16: Manufacture of computer, electronic and optical products, electrical equipment</td>
<td>ERC 4: Industrial use of processing aids in processes and products, not becoming part of articles</td>
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<tr>
<td>SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment</td>
<td>Substance supplied to that use:</td>
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<tr>
<td>Technical function of the substance during formulation:</td>
<td>As such</td>
<td></td>
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<tr>
<td>Several functions</td>
<td>In a mixture</td>
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<tr>
<td>Particulates production &amp; handling (PP&amp;H)</td>
<td>Subsequent service life relevant</td>
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<td>Chemical application:</td>
<td>Environmental release category (ERC):</td>
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<tr>
<td>ES 2</td>
<td>ERC 2: Formulation of preparations</td>
<td></td>
</tr>
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<td>Identifiers</td>
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<tr>
<td>ES 5</td>
<td>Mg containing mixtures:</td>
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<td>ES 4</td>
<td>Other industrial application</td>
<td>ERC 6a: Industrial use resulting in manufacture of another substance (use of intermediates) ERC 12a: Industrial processing of articles with abrasive techniques (low release)</td>
</tr>
<tr>
<td>ES 6</td>
<td></td>
<td>ERC 21: Low energy manipulation of substances bound in materials and/or articles</td>
</tr>
</tbody>
</table>

**Process category (PROC):**
- PROC 1: Use in closed process, no likelihood of exposure
- PROC 3: Use in closed batch process (synthesis or formulation)
- PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
- PROC 21: Low energy manipulation of substances bound in materials and/or articles
- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles
- PROC 26: Handling of solid inorganic substances at ambient temperature

**Product Category used:**
- PC 3: Air care products
- PC 7: Base metals and alloys
- PC 19: Intermediate
- PC 0: Other: pyrophoric composition

**Sector of end use:**
- SU 8: Manufacture of bulk, large scale chemicals (including petroleum products)
- SU 9: Manufacture of fine chemicals

**Technical function of the substance during use:**
- Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.
<table>
<thead>
<tr>
<th>Identifiers</th>
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<tr>
<td></td>
<td></td>
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<td>Subsequent service life relevant for that use: no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ERC 8e: Wide dispersive outdoor use of reactive substances in open systems</td>
<td>Remarks:</td>
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<tr>
<td></td>
<td></td>
<td>ERC 12a: Industrial processing of articles with abrasive techniques (low release)</td>
<td>Depending on product requirements, magnesium helps to improve strength, luminance, and weight.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Process category (PROC):</strong></td>
<td>As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
<tr>
<td></td>
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<td>PROC 3: Use in closed batch process (synthesis or formulation)</td>
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<td></td>
<td></td>
<td>PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises</td>
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<tr>
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<td>PROC 7: Industrial spraying</td>
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<tr>
<td></td>
<td></td>
<td>PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</td>
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<td>PROC 10: Roller application or brushing</td>
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<td></td>
<td>PROC 13: Treatment of articles by dipping and pouring</td>
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<td></td>
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<td>PROC 14: Production of preparations or articles by</td>
<td></td>
</tr>
<tr>
<td>Identifiers</td>
<td>Relevant exposure Scenarios</td>
<td>Use descriptors</td>
<td>Other information</td>
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<tr>
<td></td>
<td></td>
<td>tablettlng, compression, extrusion, pelletisation PROC 19: Hand-mixing with intimate contact and only PPE available. PROC 21: Low energy manipulation of substances bound in materials and/or articles PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles PROC 26: Handling of solid inorganic substances at ambient temperature</td>
<td>Product Category used: PC 7: Base metals and alloys PC 0: Other: pyrophoric composition Sector of end use: SU 10: Formulation [mixing] of preparations and/or re-packaging (excluding alloys) SU 23: Electricity, steam, gas water supply and sewage treatment Technical function of the substance during formulation: Several functions</td>
</tr>
<tr>
<td>Metallurgical uses (MU)</td>
<td>Metallurgical industry: ES 6</td>
<td>Environmental release category (ERC): ERC 4: Industrial use of processing aids in processes and products, not becoming part of articles ERC 5: Industrial use resulting in inclusion into or onto a matrix</td>
<td></td>
</tr>
</tbody>
</table>

Metallurgical industry:
ES 6
<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
</table>
| Solid forming processes (SFP) - incl. production of welding electrodes | Metal forming industry: ES 5                                                                 | **Process category (PROC):**  
PROC 1: Use in closed process, no likelihood of exposure  
PROC 2: Use in closed, continuous process with occasional controlled exposure  
PROC 3: Use in closed batch process (synthesis or formulation)  
**Product Category used:** PC 7: Base metals and alloys  
**Sector of end use:** SU 14: Manufacture of basic metals, including alloys  
**Technical function of the substance during formulation:** Several functions | Remarks:  
Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength. |
| | **Environmental release category (ERC):**  
ERC 12a: Industrial processing of articles with abrasive techniques (low release)  
**Process category (PROC):**  
PROC 21: Low energy manipulation of substances bound in materials and/or articles  
PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles  
**Product Category used:** PC 7: Base metals and alloys  
**Sector of end use:** SU 15: Manufacture of fabricated metal products, except machinery and equipment  
**Technical function of the substance during formulation:** Several functions | Substance supplied to that use:  
As such  
In a mixture  
Subsequent service life relevant for that use: yes  
Link to the subsequent service life: Solid forming processes (SFP) - incl. production of welding electrodes  
Remarks:  
Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and... |
### Identifiers

<table>
<thead>
<tr>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Welding in industrial settings (W)</strong></td>
<td><strong>Environmental release category (ERC):</strong> ERC 8c: Wide dispersive indoor use resulting in inclusion into or onto a matrix ERC 8f: Wide dispersive outdoor use resulting in inclusion into or onto a matrix <strong>Process category (PROC):</strong> PROC 25: Other hot work operations with metals PROC 21: Low energy manipulation of substances bound in materials and/or articles <strong>Product Category used:</strong> PC 7: Base metals and alloys PC 38: Welding and soldering products (with flux coatings or flux cores.), flux products PC 14: Metal surface treatment products, including galvanic and electroplating products <strong>Technical function of the substance during formulation:</strong> Several functions</td>
<td>used in electronic devices, magnesium helps to decrease the weight and to increase the strength. Substrate supplied to that use: As such In a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Welding in industrial settings (W) Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to increase the weight and to increase the strength.</td>
</tr>
</tbody>
</table>
Identifiers | Relevant exposure Scenarios | Use descriptors | Other information
---|---|---|---
occasional controlled exposure  
PROC 3: Use in closed batch process (synthesis or formulation)  
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises  
PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities  
PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities  
PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)  
PROC 13: Treatment of articles by dipping and pouring  
PROC 21: Low energy manipulation of substances bound in materials and/or articles  
PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles  
**Product Category used:**  
PC 7: Base metals and alloys  
**Sector of end use:**  
SU 15: Manufacture of fabricated metal products, except machinery and equipment  
SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment  
**Technical function of the substance during formulation:**  
Several functions

Exposure during etching of magnesium dies  
Remarks:  
Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.
(c) Uses by professional workers

<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding in professional settings (W)</td>
<td>Welding ES 8</td>
<td>Environmental release category (ERC): ERC 8c: Wide dispersive indoor use resulting in inclusion into or onto a matrix ERC 8f: Wide dispersive outdoor use resulting in inclusion into or onto a matrix Process category (PROC): PROC 25: Other hot work operations with metals PROC 21: Low energy manipulation of substances bound in materials and/or articles Product Category used: PC 7: Base metals and alloys PC 38: Welding and soldering products (with flux coatings or flux cores.), flux products Technical function of the substance during formulation: Several functions</td>
<td>Substance supplied to that use: As such In a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Welding in professional settings (W) Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
<tr>
<td>Professional use of magnesium powder in signal flares, signal rockets, marking ammunition, signalling and simulation</td>
<td>Professional ES 9</td>
<td>Environmental release category (ERC): ERC 8e: Wide dispersive outdoor use of reactive substances in open systems Process category (PROC): PROC 21: Low energy manipulation of substances bound in materials and/or articles PROC 0: Other: Use of signal flares, signal rockets or marking ammunition</td>
<td>Substance supplied to that use: As such In a mixture Subsequent service life relevant for that use: no</td>
</tr>
</tbody>
</table>
## Product safety data sheet

**Prepared in accordance with Annex II of the REACH regulation (EC) 1907/2006,**

**Version:** eSDS Magnesium Version 1.0/EN

**Revision date:** June / 2013

**Printing Date:** December 3, 2013

<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammunition and illumination</td>
<td>Technical function of the substance during formulation: Intermediates pyrophoric composition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### (d) Article service life

<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting, alloying, casting (MAC)</td>
<td>Foundry industry: ES 1</td>
<td>Article category related to subsequent service life (AC): AC 1: Vehicles AC 2: Machinery, mechanical appliances, electrical/electronic articles AC 3: Electrical batteries and accumulators AC 7: Metal articles</td>
<td>Article used by: workers Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
<tr>
<td></td>
<td>Particulate production (Mg compound): ES 2</td>
<td>Environmental release category (ERC): ERC 1: Manufacture of substances ERC 2: Formulation of preparations ERC 3: Formulation in materials ERC 4: Industrial use of processing aids in processes and products, not becoming part of articles ERC 5: Industrial use resulting in inclusion into or onto a matrix ERC 12a: Industrial processing of articles with abrasive techniques (low release)</td>
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</tr>
<tr>
<td></td>
<td>Alloys formulation: ES 3</td>
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<tr>
<td></td>
<td>Particulate production (Mg metal): ES 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifiers</td>
<td>Relevant exposure Scenarios</td>
<td>Use descriptors</td>
<td>Other information</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Solid forming processes (SFP) - incl. production of welding electrodes</td>
<td>Metal forming industry: ES 5</td>
<td>Article category related to subsequent service life (AC): AC 1: Vehicles AC 2: Machinery, mechanical appliances, electrical/electronic articles AC 3: Electrical batteries and accumulators AC 7: Metal articles Environmental release category (ERC): ERC 12a: Industrial processing of articles with abrasive techniques (low release) Process category (PROC): PROC 21: Low energy manipulation of substances bound in materials and/or articles PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles Technical function of the substance during formulation: Several functions</td>
<td>Article used by: workers Remarks: Depending on product requirements, magnesium helps to improve strenght, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
</tbody>
</table>

Corrosion protection (CP) | Chemical application: ES 1 | Article category related to subsequent service life (AC): AC 3: Electrical batteries and accumulators | Article used by: workers Remarks: |
<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
</table>
| Welding in industrial settings (W) | Welding: WS 8             | **Environmental release category (ERC):**  
ERC 1: Manufacture of substances  
**Technical function of the substance during formulation:**  
Several functions  
**Article category related to subsequent service life (AC):**  
AC 1: Vehicles  
AC 2: Machinery, mechanical appliances, electrical/electronic articles  
AC 7: Metal articles  
ERC 8c: Wide dispersive indoor use resulting in inclusion into or onto a matrix  
ERC 8f: Wide dispersive outdoor use resulting in inclusion into or onto a matrix  
**Process category (PROC):**  
PROC 21: Low energy manipulation of substances bound in materials and/or articles  
PROC 25: Other hot work operations with metals  
**Technical function of the substance during formulation:**  
Several functions  
**Article used by:**  
workers  
**Remarks:**  
Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength. |  

| Exposure during etching of magnesium dies | Etching: ES 7 | **Article category related to subsequent service life (AC):**  
AC 2: Machinery, mechanical appliances, electrical/electronic devices  
**Technical function of the substance during formulation:**  
Several functions  
**Article used by:**  
workers  
**Remarks:** |
<table>
<thead>
<tr>
<th>Identifiers</th>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
</table>
| Welding in professional settings (W) | Welding ES 8 | electrical/electronic articles  
AC 7: Metal articles  
**Environmental release category (ERC):**  
ERC 12b: Industrial processing of articles with abrasive techniques (high release)  
**Process category (PROC):**  
PROC 21: Low energy manipulation of substances bound in materials and/or articles  
PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles  
**Technical function of the substance during formulation:**  
Several functions | Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength. |
| Article category related to subsequent service life (AC):  
AC 1: Vehicles  
AC 2: Machinery, mechanical appliances, electrical/electronic articles  
AC 7: Metal articles  
**Environmental release category (ERC):**  
ERC 8c: Wide dispersive indoor use resulting in inclusion into or onto a matrix  
ERC 8f: Wide dispersive outdoor use resulting in inclusion into or onto a matrix  
**Process category (PROC):**  
PROC 21: Low energy manipulation of substances bound in materials and/or articles  
PROC 25: Other hot work operations with metals  
**Technical function of the substance during formulation:** | Article used by:  
workers  
Remarks:  
Depending on product requirements, magnesium helps to improve strength, luminance, and weight.  
As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength. |
### Identifiers

<table>
<thead>
<tr>
<th>Relevant exposure Scenarios</th>
<th>Use descriptors</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer use of pyrotechnical products (FW)</td>
<td><strong>Article category related to subsequent service life (AC):</strong>&lt;br&gt;AC 0: Other: TARIC 3604&lt;br&gt;<strong>Environmental release category (ERC):</strong>&lt;br&gt;ERC 8d: Wide dispersive outdoor use of processing aids in open systems&lt;br&gt;ERC 8e: Wide dispersive outdoor use of reactive substances in open systems&lt;br&gt;<strong>Technical function of the substance during formulation:</strong>&lt;br&gt;Several functions</td>
<td>Article used by: consumers&lt;br&gt;Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
<tr>
<td>Handling of massive objects</td>
<td><strong>Article category related to subsequent service life (AC):</strong>&lt;br&gt;AC 1: Vehicles&lt;br&gt;AC 7: Metal articles&lt;br&gt;<strong>Environmental release category (ERC):</strong>&lt;br&gt;ERC 10a: Wide dispersive outdoor use of long-life articles and materials with low release&lt;br&gt;ERC 11a: Wide dispersive indoor use of long-life articles and materials with low release&lt;br&gt;<strong>Technical function of the substance during formulation:</strong>&lt;br&gt;Several functions</td>
<td>Article used by: consumers&lt;br&gt;Remarks: Depending on product requirements, magnesium helps to improve strength, luminance, and weight. As a component in alloys and used in electronic devices, magnesium helps to decrease the weight and to increase the strength.</td>
</tr>
</tbody>
</table>
Appendix:

EXPOSURE SCENARIOS

1 Introduction – occupational exposure scenarios

Four generic exposure scenarios have been developed according to the physical form of the handled material:

- Manufacture and industrial use of magnesium metal massive
- Manufacture and industrial use of low dusty magnesium metal solids
- Manufacture and industrial use of medium dusty magnesium metal powders
- Manufacture and industrial use of high dusty magnesium metal powders

This approach has been taken in consideration of the occupational exposure assessment. For operations conducted with solid substances at ambient temperature the emission potential is considerably dependent upon the dustiness of that substance.

In addition, one exposure scenario has been developed for welding processes for the use of magnesium containing welding electrodes and/or magnesium containing objects:

- Welding in industrial and/or professional settings

1.1 Generic exposure scenario approach

Because of its applicability to all process categories (PROCs) as defined in the REACH guidance (R12), the implementation of a wide range of risk management measures (RMMs) in the tool and its ease of use enabling downstream users to use the tool as a “scaling tool”, MEASE has been used for the derivation of exposure estimates at the first tier.

During the process of occupational exposure assessment, it has been realised that a safe use could be demonstrated for each of the defined PROCs by the use of MEASE. As a consequence, it was decided to follow a “generic exposure scenario” approach. This approach is driven by two main characteristics:

1. Since magnesium metal may be placed on the market as massive object (very low emission potential) or in powder form (low, medium or high dusty), one scenario for each physical form has been developed.
2. As the above mentioned materials may be used in several processes during production or subsequent downstream use of the substance, all applicable PROCs have been assessed.

Because of the generic nature of the exposure scenarios, guidance is provided below on how to interpret, implement and comply with them. This guidance focuses on answering the following questions:

(i) How to select the appropriate exposure scenario? (How to assess the dustiness potential of specific materials?)

(ii) Which PROC is applicable to a specific process? (How to pick appropriate PROCs and associated RMMs from the exposure scenarios?)

(iii) How to deviate from the exposure scenarios but still comply with them, if the given set of RMMs does not reflect conditions at specific sites and/or facilities? (How to “scale” an exposure scenario?)
1.1.1 How to select the appropriate exposure scenario?

Since exposure scenarios have been developed for the specific physical forms, the dustiness potential of the handled material has a direct impact on exposure levels as calculated from the MEASE model. Thus defines the applicable RMMs that could be implemented to control exposure levels within the exposure scenario of interest.

During dustiness testing (with the rotating drum method) of a representative sample of magnesium powder as typically placed on the market, a dustiness value of > 10% has been derived. According to the MEASE glossary, such material would be classified as “high dusty”.

Consequently, the high dustiness scenario is the default scenario to be used for the use of magnesium powders unless a different dustiness potential is indicated by either coarser particle size of the handled material or by conducted processes which modify the dustiness potential (e.g. use in wet processes would reduce the dustiness potential, whereas high abrasion processes may increase the dustiness potential).

If the used physical form is magnesium massive metal the corresponding ES for massive objects should be used.

If doubts about the correct classification of the dustiness/emission potential remain for a specific situation, a further assessment can be made either on a qualitative or on a quantitative basis. For a qualitative assessment the MEASE glossary can be consulted, which provides guidance on this topic. A quantitative assessment can be done by conducting a dustiness test with the specific material according to the rotating drum method. It is however noted that also other dustiness tests exist, which may be used instead. For further details please refer to the European Standard EN 15051 titled “Workplace atmospheres – Measurement of the dustiness of bulk materials – Requirements and reference test methods”.

1.1.2 Which PROC is applicable to a specific process?

The selection of one or more appropriate PROC(s) for a specific occupational operation is a fundamental step when applying the “generic exposure scenario” approach. Currently, 29 different process categories are defined in the guidance (R.12). These categories are defined by one or a combination of the below listed characteristics:

1. Activity and or task (e.g. PROC 5 for mixing operations)
2. Scale of operation (e.g. PROC 7 for spraying industrial settings, PROC 11 for spraying in non-industrial settings, PROC 15 for tasks in laboratories)
3. Level of containment (e.g. PROC 1 in closed systems, PROC 2 in almost closed systems, PROC 3 in semi-open systems and PROC 4 in more or less open systems)
4. Physical form of the handled material (e.g. PROC 21 for the handling of massive objects)
5. Level of control (PROC 8a vs. PROC 8b or PROC 26 for powders)

This categorisation system provides a high level of flexibility when assigning PROCs to processes conducted at a certain site. As a drawback, this flexibility in assigning PROCs may also lead to different interpretations of which PROC is applicable to a specific process. Definitive guidance on the selection of the correct PROC can therefore not be provided. However, based on the PROC characteristics above, some guidance on “good practice of PROC selection” is provided below.

As any selected PROC should describe individual uses (processes) for which a safe use has to be demonstrated, the demonstration process itself has to be taken into account when selecting PROCs. As an integral part of this demonstration process, the exposure assessment is based on the emission potential associated with the conducted process. Thus, any PROC selection should be based on the main driver of the emission potential of a process. The following examples are intended to highlight this selection process. It is again noted that different assignments can be made according to individual interpretations.
Example I

Setting: Magnesium powder is pneumatically transferred from a storage silo in closed piping systems to a closed mixing vessel and subsequently mixed with another substance. The mixture is transferred from the mixing vessel into intermediate storage silos using closed piping systems.

PROC assignment: As the emission potential is clearly driven by the containment of the process, either PROC 1 or PROC 2 seems to be applicable. PROC 5 for mixing operations would be more appropriate if the process would be conducted in an open system, in which the emission potential would be driven by process intrinsic emission potential.

Example II

Setting: Magnesium powder is delivered in drums and pneumatically discharged into storage silos by means of closed piping systems.

PROC assignment: PROC 26 or PROC 8b seems to be applicable because of the highly controlled nature of the process. The same process in a situation where reduced dust control measures were employed would potentially require PROC 8a to be assigned.

1.1.3 How to deviate from the exposure scenarios but still comply with them, if the given set of RMMs does not reflect conditions at specific sites and/or facilities?

It is assumed that a broad range of producers and downstream users are already covered by the exposure scenarios because of their generic nature. In specific situations, an exposure scenario may however not fully reflect the operational conditions and RMMs that are in place at a certain site. For these situations, guidance is provided below to demonstrate how the MEASE model can be used to obtain compliance with the DNEL contained in the exposure scenario of interest, as required under REACH.

As MEASE (www.ebrc.de/mease.html) has been used to derive exposure estimates, the tool can also be used to reflect any deviations from the assumptions made in the conducted exposure assessment. For this purpose, the assessor should initially enter all parameters in the tool without modifications to ensure a correct reflection of the original exposure scenario. All parameters needed to run the tool can be found in the exposure scenario. In the next step, the assessor can alternate the parameters according to his specific needs or existing control equipment employed at the facility (e.g. assuming higher efficiency of local exhaust ventilation and increasing exposure duration). If the resulting exposure estimate is below the respective DNEL, a safe use is demonstrated and compliance with the exposure scenario is maintained. It is suggested to keep records of such assessments.

If it is not possible to demonstrate that the DNEL has not been exceeded, either other exposure assessment tools or measured data may be used. For the use of measured data in exposure assessments, detailed information can be found in the REACH guidance (R14). It is noted that for a specific workplace at a single company, 6 data points are needed as a minimum for an exposure assessment.

1.1.4 Selection of appropriate respiratory equipment

Any RPE as defined in the exposure scenarios below shall only be worn if the following principles are implemented in parallel: The duration of work (compare with “duration of exposure” above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker’s capability of using tools and of communicating are reduced during the wearing of RPE.

For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.

The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.

An overview of ”assigned protection factors” (APFs) of different RPE can be found in BS EN 529:2005 and in the glossary of MEASE.
1.1.5 List of PROCs included in the exposure scenarios below

The following PROCs are included in the exposure scenarios below. It is noted that some combinations of the physical form of the handled material and the conducted process (category) may not be relevant (e.g. industrial spraying of a massive object) and are therefore not included in the exposure scenarios below. Additionally, it is noted that some PROCs may exclusively apply to industrial settings, some may only apply to professional settings and some may be relevant for both types.

<table>
<thead>
<tr>
<th>PROC</th>
<th>REACH definition</th>
<th>Examples and explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROC 1</td>
<td>Use in closed process, no likelihood of exposure</td>
<td>Use of the substances in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems</td>
</tr>
<tr>
<td>PROC 2</td>
<td>Use in closed, continuous process with occasional controlled exposure</td>
<td>Continuous process but where the design philosophy is not specifically aimed at minimizing emissions. It is not high integrity and occasional exposure will arise e.g. through maintenance, sampling and equipment breakages</td>
</tr>
<tr>
<td>PROC 3</td>
<td>Use in closed batch process (synthesis or formulation)</td>
<td>Batch manufacture of a chemical or formulation where the predominant handling is in a contained manner, e.g. through enclosed transfers, but where some opportunity for contact with chemicals occurs, e.g. through sampling</td>
</tr>
<tr>
<td>PROC 4</td>
<td>Use in batch and other process (synthesis) where opportunity for exposure arises</td>
<td>Use in batch manufacture of a chemical where significant opportunity for exposure arises, e.g. during charging, sampling or discharge of material, and when the nature of the design is likely to result in exposure</td>
</tr>
<tr>
<td>PROC 7</td>
<td>Industrial spraying</td>
<td>Air dispersive techniques Spraying for surface coating, adhesives, polishes/cleaners, air care products, sandblasting Substances can be inhaled as aerosols. The energy of the aerosol particles may require advanced exposure controls; in case of coating, overspray may lead to waste water and waste.</td>
</tr>
<tr>
<td>PROC 8a</td>
<td>Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</td>
<td>Sampling, loading, filling, transferring, dumping, bagging in non-dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.</td>
</tr>
<tr>
<td>PROC 8b</td>
<td>Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</td>
<td>Sampling, loading, filling, transfer, dumping, bagging in dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.</td>
</tr>
<tr>
<td>PROC 9</td>
<td>Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</td>
<td>Filling lines specifically designed to both capture vapour and aerosol emissions and minimise spillage</td>
</tr>
<tr>
<td>PROC 10</td>
<td>Roller application or brushing</td>
<td>Low energy spreading of e.g. coatings Including cleaning of surfaces. Substance can be inhaled as vapours, skin contact can occur through droplets, splashes, working with wipes and handling of treated surfaces.</td>
</tr>
<tr>
<td>PROC 13</td>
<td>Treatment of articles by dipping and pouring</td>
<td>Immersion operations Treatment of articles by dipping, pouring, immersing, soaking, washing out or washing in substances; including cold formation or resin type matrix. Includes handling of treated objects (e.g. after dying, plating). Substance is applied to a surface by low energy techniques such as dipping the article into a bath or pouring a preparation onto a surface.</td>
</tr>
<tr>
<td>PROC 14</td>
<td>Production of preparations or articles by tabletting, compression, extrusion, pelletisation</td>
<td>Processing of preparations and/or substances (liquid and solid) into preparations or articles. Substances in the chemical matrix may be exposed to elevated mechanical and/or thermal energy conditions. Exposure is predominantly related to volatiles and/or generated fumes, dust may be formed as well.</td>
</tr>
<tr>
<td>PROC 19</td>
<td>Hand-mixing with intimate contact and only PPE available.</td>
<td>Addresses occupations where intimate and intentional contact with substances occurs without any specific exposure controls other than PPE.</td>
</tr>
<tr>
<td>PROC</td>
<td>REACH definition</td>
<td>Examples and explanations</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PROC 21</td>
<td>Low energy manipulation of substances bound in materials and/or articles</td>
<td>Manual cutting, cold rolling or assembly/disassembly of material/article (including metals in massive form), possibly resulting in the release of fibres, metal fumes or dust</td>
</tr>
<tr>
<td>PROC 22</td>
<td>Potentially closed processing operations with minerals/metals at elevated temperature Industrial setting</td>
<td>Activities at smelters, furnaces, refineries, coke ovens. Exposure related to dust and fumes to be expected. Emission from direct cooling may be relevant.</td>
</tr>
<tr>
<td>PROC 23</td>
<td>Open processing and transfer operations with minerals/metals at elevated temperature</td>
<td>Sand and die casting, tapping and casting melted solids, dressing of melted solids, hot dip galvanising, raking of melted solids in paving Exposure related to dust and fumes to be expected</td>
</tr>
<tr>
<td>PROC 24</td>
<td>High (mechanical) energy work-up of substances bound in materials and/or articles</td>
<td>Substantial thermal or kinetic energy applied to substance (including metals in massive form) by hot rolling/forming, grinding, mechanical cutting, drilling or sanding. Exposure is predominantly expected to be to dust. Dust or aerosol emission as result of direct cooling may be expected.</td>
</tr>
<tr>
<td>PROC 25</td>
<td>Other hot work operations with metals</td>
<td>Welding, soldering, gouging, brazing, flame cutting Exposure is predominantly expected to fumes and gases.</td>
</tr>
<tr>
<td>PROC 26</td>
<td>Handling of solid inorganic substances at ambient temperature</td>
<td>Transfer and handling of ores, concentrates, raw metal oxides and scrap; packaging, un-packaging, mixing/blending and weighing of metal powders or other minerals</td>
</tr>
</tbody>
</table>
2 Introduction – environmental exposure

2.1 General
An Exposure Scenario (ES) is a set of information describing the conditions under which the risks associated with the identified use(s) of a substance can be controlled. It includes operational conditions (such as duration and frequency of use or the amount used, process temperature, releases) and necessary risk management measures (e.g. waste water and gas treatment). The final ES also includes information on estimated exposure and guidance to downstream user to evaluate whether he works inside the boundaries set by the ES.

In order to obtain realistic exposure estimates, recent data from production and use sites regarding the industrial processes, applied risk management measures (RMM), operational conditions (OC), measured emission data, etc. have been collected through questionnaires. These data collected from specific sites form the base dataset on operational conditions, emissions and exposure. These data are grouped by sector and summarised by means of the median, 90th percentile, minimum and maximum levels, according to data availability.

The proposed generic safe use ES for each sector has been developed on the basis of the data provided by individual sites or on generic assumptions if no other data available. In order to establish the ES for a specific sector, operational conditions, tonnage, duration/frequency, RMMs, release factors & dilution capacity in the environment have been combined as such that safe use for a certain endpoint can be demonstrated.

More specifically,

1. Tonnage was selected in order to be representative for a large or a representative customer of a sector
2. Release factor was selected to reflect reasonable worst case or typical conditions (typical processes should be covered)
3. Duration/frequency was selected to be typical
4. Applied RMMs were selected to be representative for a sector
5. Dilution capacity of the environment was selected to be reasonable worst case or typical

Local environmental exposure concentrations in air, water, sediment and soil are based on modelling calculations. The Tier 1 modelling tool EUSES (version 2.1) was used to assess the environmental exposure.

Safe use is demonstrated if the estimated exposure level (PEC) is below the respective predicted no effect concentration (PNEC), which is expressed in the risk characterisation ratio (RCR). The PNECs for the aquatic (freshwater), sediment and soil compartment are respectively 410 µg Mg/L, 268 mg Mg/kg dw and 268 mg Mg/kg dw. No specific exposure scenarios were developed for the marine environment. Taking into account that no risks were identified for the freshwater compartment, the higher dilution factors for deriving local marine PECs (resulting in lower PECs), and the very high natural background concentration of Mg in seawater (1290 mg Mg/L) no risks are expected for the marine aquatic and sediment compartment.

The environmental risk assessment for Mg is based on added concentrations. Magnesium is abundantly present in all environmental compartments and both the predicted no effect concentrations and the predicted contribution of industrial emissions are small compared to the high natural background concentration of Mg in the environment (difference larger than a factor 10; Table 1).

Also no diffuse anthropogenic emission modelling has been performed because it has been assumed that the anthropogenic emissions are only a very small fraction compared to the large natural background. Therefore, the local predicted environmental concentrations (PEClocal,added) are based on Clocal only (no diffuse regional emissions and natural background contribution taken into account).
Table 1: Typical baseline concentrations and PNEC_{added} values for magnesium in water, sediment and soil.

<table>
<thead>
<tr>
<th>Compartment (freshwater)</th>
<th>Unit</th>
<th>10\textsuperscript{th} percentile of baseline concentrations</th>
<th>Typical (50\textsuperscript{th} percentile baseline level)</th>
<th>90\textsuperscript{th} percentile of baseline concentrations</th>
<th>PNEC_{added}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic (freshwater)</td>
<td>mg Mg/l</td>
<td>2.9</td>
<td>7.1</td>
<td>22.0</td>
<td>0.41</td>
</tr>
<tr>
<td>Aquatic (marine water)</td>
<td>mg Mg/l</td>
<td>1290</td>
<td></td>
<td></td>
<td>0.41</td>
</tr>
<tr>
<td>Sediment (freshwater)</td>
<td>mg Mg/kg dw</td>
<td>2512</td>
<td>6918</td>
<td>19041</td>
<td>268</td>
</tr>
<tr>
<td>Soil</td>
<td>mg Mg/kg dw</td>
<td>1459</td>
<td>3930</td>
<td>11051</td>
<td>268</td>
</tr>
</tbody>
</table>

The PNEC_{added} values for sediment and soil are calculated with the equilibrium partitioning approach. Therefore, the PEC/PNEC ratio for these compartments should be theoretically increased by a factor 10 in order to take uptake by ingestion of sediment or soil into account when adsorption is high (Chapter R10 of the REACH Guidance on Information Requirements & Chemical Safety Assessment). For metals no specific Kd thresholds are available. This extra factor 10 was not taken into account in the risk assessment for magnesium because i) PNEC_{added} values are more than a factor 10 below the typical natural background concentration of Mg in sediment and soil and ii) Mg is a major essential element for living organisms and uptake is often actively controlled (homeostasis).

2.2 Local exposure calculation factors

The following input values and assumptions were used in the local exposure assessment for magnesium:

- Number of release days: the assessment was based on the lowest number of release days per year from the questionnaires.
- Annual tonnage: calculations were done based upon the maximum tonnage of magnesium manufactured or used per year from the questionnaires.
- Release factors: Generic exposure scenarios are applied to the sites that did not provide any quantitative emission information and for which production/use data and/or specific process information are available. The emissions to water and air are calculated by multiplying usage/production figures with a default emission factor for water and air based on the most appropriate specific environmental release categories (spERC). Chapter R16 of the REACH Guidance on Information Requirements & Chemical Safety Assessment introduces Environmental Release Classes (ERC) as generic, broadly applicable emission scenarios. They define the fractions of a substance emitted during a process/application, and provide default assumptions for the local environmental properties. While these ERCs provide for standardization, they lead to unrealistically conservative emission estimates. The REACH Guidance acknowledges that an “ERC should be used as a starting point for emission estimation” and therefore explicitly encourages the use of more refined or specific information for emissions. Specific ERCs (spERCs) for metals and metal compounds were developed by ARCHE in collaboration with Eurometaux. Information on the development and use of these spERCs can be found on www.arche-consulting.be/Metal-CSA-toolbox/spERCs-tool-for-metals.
- Fraction of emission directed to sludge by „off-site? municipal Sewage Treatment Plant: There is always one (on site or off site) water treatment considered. If the waste water is treated in a municipal sewage treatment plant a fraction of the emission is directed to the effluent water, the other fraction is going to the sludge. Since no data are available for the STP removal efficiency of magnesium, a default removal efficiency of 50% has been assumed (F_{sludge}=0.5, F_{water}=0.5; REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals).
- Sludge from an on-site wastewater treatment plant (WWTP) is assumed to be disposed of together with waste (specified for different companies; disposal, recycling) and hence it is not applied to agricultural soil. Sludge from a municipal STP is assumed to be applied to agricultural soil.
- Dilution factor to the aquatic compartment: In general a default dilution factor of 10 and 100 was
assumed for the freshwater compartment and marine environment, respectively. Regarding the generic exposure scenario for use of metal compounds, a specific dilution factor of 20 was used for the freshwater compartment.

Partition coefficient solids-water in sediment/soil/suspended matter: Only a Kp value is available for partitioning of Mg in sediment: Log Kpsediment = 2.815 l/kg. This Kp for sediment is also used as a screening approach for partitioning in soils and suspended matter (see also Chapter 4 of the CSR).

Please note that if a downstream user (DU) does not comply with operational conditions and RMMs stipulated in the safe use ES, it is recommended to evaluate whether he works inside the boundaries set by the ES through scaling (see section 4 of each environmental exposure scenario below).
ES1: Manufacture and recycling of massive metal and metal powder (for Melting, alloying, casting & Corrosion protection)

<table>
<thead>
<tr>
<th>Exposure Scenario Format (1) addressing uses carried out by workers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Title</strong></td>
</tr>
<tr>
<td>Free short title</td>
</tr>
<tr>
<td>Systematic title based on use descriptor</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>2. Operational conditions and risk management measures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Contributing scenario (1) controlling environmental exposure</strong></td>
</tr>
<tr>
<td>Name of contributing scenario</td>
</tr>
<tr>
<td>Further specification</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Product characteristic</td>
</tr>
<tr>
<td>Amounts used</td>
</tr>
<tr>
<td>Frequency and duration of use/exposure</td>
</tr>
<tr>
<td>Environment factors not influenced by risk management</td>
</tr>
<tr>
<td>Other given operational conditions affecting environmental exposure</td>
</tr>
<tr>
<td>Technical conditions and measures at process level (source) to prevent release</td>
</tr>
</tbody>
</table>
## Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Different kinds of RMM to prevent releases to the environment are possible:

**Water:**
- Chemical precipitation
- Sedimentation
- Filtration
- Electrolysis (not common)

**Air:**
- Fabric or bag filters (most common)
- Wet scrubbers (second most common)
- Electrostatic precipitation (not common)
- Ceramic filters
- Dry or demi-dry scrubbers

Emission factors are based on the metal spERCs:

- Release to water: 0.01%
- Release to air: 0.03%

## Organizational measures to prevent/limit release from site

No specific organizational measures were considered.

## Conditions and measures related to municipal sewage treatment plant

A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required.

## Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible.

## Conditions and measures related to external recovery of waste

None

## 2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

### Name of contributing scenario

Manufacture and industrial uses of magnesium metal massive

### Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25

### Product characteristic

This contributing scenario applies to all industrial uses of magnesium metal massive.

### Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

### Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

### Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

### Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted. Please note that magnesium massive metal is not classified.
**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

**Conditions and measures related to personal protection, hygiene and health evaluation**

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

**2.3 Contributing scenario (3) controlling worker exposure for the handling of low dusty magnesium metal powders**

**Name of contributing scenario**

Manufacture and industrial uses of low dusty magnesium metal powders

**Further specification**

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 21, 22, 23, 24, 25, 26

**Product characteristic**

This contributing scenario applies to all industrial uses of low dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.
Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/ dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.4 Contributing scenario (4) controlling worker exposure for the handling of medium dusty magnesium metal powders

Name of contributing scenario

Manufacture and industrial uses of medium dusty magnesium metal powders

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
**Conditions and measures related to personal protection, hygiene and health evaluation**

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 2.5 Contributing scenario (5) controlling worker exposure for the handling of high dusty magnesium metal powders

#### Name of contributing scenario

Manufacture and industrial uses of high dusty magnesium metal powders

#### Further specification

**PROCs covered in this scenario:** PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

#### Product characteristic

This contributing scenario applies to all industrial uses of high dusty magnesium metal powders.

#### Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

#### Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

#### Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

#### Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

#### Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

#### Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

#### Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
### Conditions and measures related to personal protection, hygiene and health evaluation

<table>
<thead>
<tr>
<th>PROC</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 8b, 9, 10, 14, 19, 26</td>
<td>FFP1 mask</td>
<td>APF=4</td>
<td>gloves are optional for mechanical/heat protection where needed</td>
<td>standard working clothes (overall long sleeve) and safety shoes</td>
</tr>
<tr>
<td>8a</td>
<td>FFP2 mask</td>
<td>APF=10</td>
<td></td>
<td>antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists</td>
</tr>
<tr>
<td>7</td>
<td>FFP3 mask</td>
<td>APF=20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3, 13, 22, 23, 24, 25</td>
<td>not required</td>
<td>na</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 3. Exposure estimation and reference to its source

#### Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.

#### Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
<th>Metal spERC: Manufacture and recycling of massive metal and metal powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>100</td>
<td>g/T</td>
<td>Metal spERC: Manufacture and recycling of massive metal and metal powder</td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>300</td>
<td>g/T</td>
<td>Metal spERC: Manufacture and recycling of massive metal and metal powder</td>
</tr>
<tr>
<td>Tonnage</td>
<td>4000</td>
<td>T Mg</td>
<td></td>
</tr>
<tr>
<td>Emission days</td>
<td>230</td>
<td>days</td>
<td></td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compartment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PECadd STP</td>
<td>0.43</td>
<td>mg/l</td>
<td>10.8</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>43.1</td>
<td>µg/l</td>
<td>410</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>27.9</td>
<td>mg/kg dw</td>
<td>268</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>20.8</td>
<td>mg/kg dw</td>
<td>268</td>
</tr>
<tr>
<td>PECadd,air (100 m)</td>
<td>914</td>
<td>ng/m³</td>
<td></td>
</tr>
</tbody>
</table>

### 4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

#### Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL inhalation: 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 “Generic exposure scenario approach” above.
### Environmental emissions

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.


In the registrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

### Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 2: Manufacture of metal compounds (for Melting, alloying, casting & Corrosion protection)

<table>
<thead>
<tr>
<th>Exposure Scenario Format (1) addressing uses carried out by workers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Title</strong></td>
</tr>
<tr>
<td>Free short title: Manufacture of metal compounds (for Melting, alloying, casting &amp; Corrosion protection)</td>
</tr>
<tr>
<td>Systematic title based on use descriptor: SU3, SU14, SU15, SU16, SU17, PC7, PC14, AC1, AC2, AC3, AC7 (appropriate PROCs and ERCs are given in Section 2 below)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes, tasks and/or activities covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes, tasks and/or activities covered are described in Section 2 below.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Operational conditions and risk management measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Contributing scenario (1) controlling environmental exposure</strong></td>
</tr>
<tr>
<td>Name of contributing scenario: Environmental exposure during manufacture of metal compounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Further specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERCs covered in this scenario: ERC 1</td>
</tr>
</tbody>
</table>

Instead of using the default ERC1 values from the ECHA guidance, spERCs based upon measured data are used. Following sectors are covered by the spERC for manufacture of metal compounds:
- Use of magnesium as a reactant (Grignard)
- Production of Mg-articiles for biomedical application

<table>
<thead>
<tr>
<th>Product characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not relevant for exposure estimation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amounts used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amounts up to 1000 ton Mg/year can be used at one site (generic value)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency and duration of use/exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of operating days: 100 (default based on tonnage)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment factors not influenced by risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td>A default dilution factor of 10 is taken into account for freshwater</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other given operational conditions affecting environmental exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical conditions and measures at process level (source) to prevent release</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different kinds of RMM to prevent releases to the environment are possible:</td>
</tr>
<tr>
<td>Water:</td>
</tr>
<tr>
<td>- Chemical precipitation</td>
</tr>
<tr>
<td>- Sedimentation</td>
</tr>
<tr>
<td>- Filtration</td>
</tr>
<tr>
<td>- Electrolysis (not common)</td>
</tr>
<tr>
<td>Air:</td>
</tr>
<tr>
<td>- Fabric or bag filters (most common)</td>
</tr>
<tr>
<td>- Wet scrubbers (second most common)</td>
</tr>
<tr>
<td>- Electrostatic precipitation (not common)</td>
</tr>
<tr>
<td>- Ceramic filters</td>
</tr>
<tr>
<td>- Dry or demi-dry scrubbers</td>
</tr>
</tbody>
</table>

Emission factors are based on the metal spERCs:
The metal spERC for Manufacture of metal compounds v 1.1 has been used:
Release to water: 0.02 %
Release to air: 0.03 %
### Organizational measures to prevent/limit release from site

No specific organizational measures were considered.

### Conditions and measures related to municipal sewage treatment plant

A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13–2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required.

### Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible.

### Conditions and measures related to external recovery of waste

None.

### 2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

#### Name of contributing scenario

Manufacture and industrial uses of magnesium metal massive.

#### Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25.

#### Product characteristic

This contributing scenario applies to all industrial uses of magnesium metal massive.

#### Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

#### Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

#### Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

#### Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted. Please note that magnesium massive metal is not classified.

#### Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

#### Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

#### Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
## Conditions and measures related to personal protection, hygiene and health evaluation

### Standard working clothes related exposure

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 2.3 Contributing scenario (3) controlling worker exposure for the handling of low dusty magnesium metal powders

<table>
<thead>
<tr>
<th>Name of contributing scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture and industrial uses of low dusty magnesium metal powders</td>
</tr>
</tbody>
</table>

### Further specification

**PROCs covered in this scenario:** PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 21, 22, 23, 24, 25, 26

### Product characteristic

This contributing scenario applies to all industrial uses of low dusty magnesium metal powders.

### Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

### Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

### Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

### Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, thus direct contact of magnesium powder with water has to be omitted.

### Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

### Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

### Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes attend of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

### Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 2.4 Contributing scenario (4) controlling worker exposure for the handling of medium dusty magnesium metal powders

<table>
<thead>
<tr>
<th>Name of contributing scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture and industrial uses of medium dusty magnesium metal powders</td>
</tr>
</tbody>
</table>
Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.5 Contributing scenario (5) controlling worker exposure for the handling of high dusty magnesium metal powders

Name of contributing scenario

Manufacture and industrial uses of high dusty magnesium metal powders

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of high dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.
Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions.

For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

<table>
<thead>
<tr>
<th>PROC</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 8b, 9, 10, 14, 19, 26</td>
<td>FFP1 mask</td>
<td>APF=4</td>
<td></td>
<td>standard working clothes (overall long sleeve) and safety shoes</td>
</tr>
<tr>
<td>8a</td>
<td>FFP2 mask</td>
<td>APF=10</td>
<td>gloves are optional for mechanical/heat protection where needed</td>
<td>antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists</td>
</tr>
<tr>
<td>7</td>
<td>FFP3 mask</td>
<td>APF=20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3, 13, 22, 23, 24, 25</td>
<td>not required</td>
<td>na</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

3. Exposure estimation and reference to its source

Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.
Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
<th>Metal spERC: Manufacture of metal compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>200</td>
<td>g/T</td>
<td></td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>300</td>
<td>g/T</td>
<td></td>
</tr>
<tr>
<td>Tonnage</td>
<td>1000</td>
<td>T Mg</td>
<td></td>
</tr>
<tr>
<td>Emission days</td>
<td>100</td>
<td>days</td>
<td></td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartment</th>
<th>PNECadd</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PECadd STP</td>
<td>0.50</td>
<td>10.8</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>49.5</td>
<td>410</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>32.1</td>
<td>268</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>23.5</td>
<td>268</td>
</tr>
<tr>
<td>PECadd,air (100 m)</td>
<td>228</td>
<td></td>
</tr>
</tbody>
</table>

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL_{inhalation} = 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 “Generic exposure scenario approach” above.

Environmental emissions

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.


In the registrrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 3: Formulation of massive metal and metal powder (Alloying) (for Melting, alloying, casting & Particulates production and handling & Fine particulates production)

### Exposure Scenario Format (1) addressing uses carried out by workers

**1. Title**

<table>
<thead>
<tr>
<th>Free short title</th>
<th>Formulation of massive metal and metal powder (Alloying) (for Melting, alloying, casting &amp; Particulates production and handling &amp; Fine particulates production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematic title based on use descriptor</td>
<td>SU3, SU8, SU9, SU10, SU14, SU15, SU16, SU17, SU23, PC3, PC7, PC19, AC1, AC2, AC3, AC7 (appropriate PROCs and ERCs are given in Section 2 below)</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered</td>
<td>Processes, tasks and/or activities covered are described in Section 2 below.</td>
</tr>
</tbody>
</table>

**2. Operational conditions and risk management measures**

**2.1 Contributing scenario (1) controlling environmental exposure**

**Name of contributing scenario**

1. Environmental exposure during formulation of massive metal and metal powder (Alloying)

**Further specification**

- ERCs covered in this scenario: ERC 2,3

Instead of using the default ERC2 and 3 values from the ECHA guidance, spERCs based upon measured data are used. Following sectors are covered by the spERC for formulation of massive metal and metal powder:
- Alloys formulation

**Product characteristic**

- Magnesium can be in the form of raw materials, scrap or ingots

**Amounts used**

- Amounts up to 4000 ton Mg/year can be used at one site (highest value based on 3 questionnaires)

**Frequency and duration of use/exposure**

- Number of operating days: 230 (lowest value based on 3 questionnaires)

**Environment factors not influenced by risk management**

- A default dilution factor of 10 is taken into account for freshwater

**Other given operational conditions affecting environmental exposure**

- Alloying happens indoor.

**Technical conditions and measures at process level (source) to prevent release**

- None
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Different kinds of RMM to prevent releases to the environment are possible:

- Water:
  - Chemical precipitation
  - Sedimentation
  - Filtration
  - Electrolysis (not common)

- Air:
  - Fabric or bag filters (most common)
  - Wet scrubbers (second most common)
  - Electrostatic precipitation (not common)
  - Ceramic filters
  - Dry or demi-dry scrubbers

Emission factors are based on the metal spERCs:

- Release to water: 0.003 %
- Release to air: 0.007 %

Organizational measures to prevent/limit release from site

No specific organizational measures were considered.

Conditions and measures related to municipal sewage treatment plant

A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required.

Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible.

Conditions and measures related to external recovery of waste

None.

2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

Name of contributing scenario

Manufacture and industrial uses of magnesium metal massive

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25

Product characteristic

This contributing scenario applies to all industrial uses of magnesium metal massive.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g., 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g., no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted.

Please note that magnesium massive metal is not classified.
**PRODUCT SAFETY DATA SHEET**


**Version: SDS Magnesium, Draft Version 1.0/EN**

**Revision date: June / 2013**

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

**Conditions and measures related to personal protection, hygiene and health evaluation**

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/ dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 2.3 Contributing scenario (3) controlling worker exposure for the handling of low dusty magnesium metal powders

**Name of contributing scenario**

Manufacture and industrial uses of low dusty magnesium metal powders

**Further specification**

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 21, 22, 23, 24, 25, 26

**Product characteristic**

This contributing scenario applies to all industrial uses of low dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
Manufacturing and industrial uses of medium dusty magnesium metal powders

Further specification

Types of processes covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.4 Contributing scenario (4) controlling worker exposure for the handling of medium dusty magnesium metal powders

Name of contributing scenario

Manufacture and industrial uses of medium dusty magnesium metal powders

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.5 Contributing scenario (5) controlling worker exposure for the handling of high dusty magnesium metal powders

Name of contributing scenario

Manufacture and industrial uses of high dusty magnesium metal powders
**PRODUCT SAFETY DATA SHEET**


<table>
<thead>
<tr>
<th>Further specification</th>
<th>PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26</th>
</tr>
</thead>
</table>

**Product characteristic**

This contributing scenario applies to all industrial uses of high dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, thus direct contact of magnesium powder with water has to be omitted.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

**Conditions and measures related to personal protection, hygiene and health evaluation**

<table>
<thead>
<tr>
<th>PROC</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 8b, 9, 10, 14, 19, 26</td>
<td>FFP1 mask</td>
<td>APF=4</td>
<td>gloves are optional for mechanical/heat protection where needed</td>
<td>standard working clothes (overall long sleeve) and safety shoes</td>
</tr>
<tr>
<td>8a</td>
<td>FFP2 mask</td>
<td>APF=10</td>
<td></td>
<td>antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists</td>
</tr>
<tr>
<td>7</td>
<td>FFP3 mask</td>
<td>APF=20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3, 13, 22, 23, 24, 25</td>
<td>not required</td>
<td>na</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.
3. Exposure estimation and reference to its source

Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.

Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>30</td>
<td>g/T Metal spERC: Formulation of massive metal and metal powder</td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>70</td>
<td>g/T Metal spERC: Formulation of massive metal and metal powder</td>
</tr>
<tr>
<td>Tonnage</td>
<td>4000</td>
<td>T Mg</td>
</tr>
<tr>
<td>Emission days</td>
<td>230</td>
<td>days</td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PECcadd STP</td>
</tr>
<tr>
<td>PEClocal,add in aquatic (freshwater)</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
</tr>
<tr>
<td>PECcadd,air (100 m)</td>
</tr>
</tbody>
</table>

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL_inhalation: 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 "Generic exposure scenario approach" above.

Environmental emissions

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

The Metal EUSES calculator for DUs can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. In the registrant-interface, the generic default OCs and RMMs can be entered. In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
**ES 4: Formulation of metal compounds – incl. production of fireworks (for Particulates production and handling & Fine particulates production)**

### Exposure Scenario Format (1) addressing uses carried out by workers

<table>
<thead>
<tr>
<th>1. Title</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Free short title</strong></td>
</tr>
<tr>
<td><strong>Systematic title based on use descriptor</strong></td>
</tr>
<tr>
<td><strong>Processes, tasks and/or activities covered</strong></td>
</tr>
</tbody>
</table>

#### 2. Operational conditions and risk management measures

##### 2.1 Contributing scenario (1) controlling environmental exposure

<table>
<thead>
<tr>
<th>Name of contributing scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental exposure during formulation of metal compounds</td>
</tr>
</tbody>
</table>

**Further specification**

- ERCs covered in this scenario: ERC 2,3

Instead of using the default ERC2 and 3 values from the ECHA guidance, spERCs based upon measured data are used. Following sectors are covered by the spERC for formulation of metal compounds:
  - Formulation of magnesium containing mixtures
  - Fireworks formulation
  - Production of military pyrotechnics (torches and signal rockets)
  - Cored wire formulation

**Product characteristic**

- Magnesium is used in powder, granule or grain form

**Amounts used**

- Amounts up to 100 ton Mg/year can be used at one site (highest value based on 3 questionnaires)

**Frequency and duration of use/exposure**

- Number of operating days: 190 (lowest value based on 3 questionnaires)

**Environment factors not influenced by risk management**

- A default dilution factor of 10 is taken into account for freshwater

**Other given operational conditions affecting environmental exposure**

- Formulation happens indoor.

**Technical conditions and measures at process level (source) to prevent release**

- None
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Different kinds of RMM to prevent releases to the environment are possible:

**Water:**
- Chemical precipitation
- Sedimentation
- Filtration
- Electrolysis (rare)

**Air:**
- Fabric or bag filters (most common)
- Wet scrubbers (most common)
- Electrostatic precipitation
- Ceramic filters
- Dry or demi-dry scrubbers

Emission factors are based on the metal spERCs:

The metal spERC for Formulation of metal compounds v 1.1 has been used:

- Release to water: 0.5%
- Release to air: 0.004%

Organizational measures to prevent/limit release from site

No specific organizational measures were considered.

Conditions and measures related to municipal sewage treatment plant

A default municipal STP has been taken into account with a removal efficiency for Mg of 50%. If no municipal STP is available an on-site treatment with at least the same efficiency is required (see 9.0.2.2).

Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible

Conditions and measures related to external recovery of waste

None

2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

Name of contributing scenario

Manufacture and industrial uses of magnesium metal massive

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25

Product characteristic

This contributing scenario applies to all industrial uses of magnesium metal massive.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions.

For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

Please note that magnesium massive metal is not classified.
### Technical conditions and measures at process level (source) to prevent release
Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

### Technical conditions and measures to control dispersion from source towards the worker
Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

### Organisational measures to prevent/limit releases, dispersion and exposure
Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

### Conditions and measures related to personal protection, hygiene and health evaluation
Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

## 2.3 Contributing scenario (3) controlling worker exposure for the handling of low dusty magnesium metal powders

### Name of contributing scenario
Manufacture and industrial uses of low dusty magnesium metal powders

### Further specification
PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 21, 22, 23, 24, 25, 26

### Product characteristic
This contributing scenario applies to all industrial uses of low dusty magnesium metal powders.

### Amounts used
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

### Frequency and duration of use/exposure
The exposure duration is not restricted for all applicable processes in this scenario.

### Human factors not influenced by risk management
The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

### Other given operational conditions affecting workers exposure
Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:
- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention, the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

### Technical conditions and measures at process level (source) to prevent release
Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).
Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/ dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.4 Contributing scenario (4) controlling worker exposure for the handling of medium dusty magnesium metal powders

Name of contributing scenario

Manufacture and industrial uses of medium dusty magnesium metal powders

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency  and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention, the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

2.5 Contributing scenario (5) controlling worker exposure for the handling of high dusty magnesium metal powders

Name of contributing scenario
Manufacture and industrial uses of high dusty magnesium metal powders

Further specification
PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

Product characteristic
This contributing scenario applies to all industrial uses of high dusty magnesium metal powders.

Amounts used
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure
The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management
The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure
Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:
- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.
To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release
Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker
Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent/limit releases, dispersion and exposure
Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
### Conditions and measures related to personal protection, hygiene and health evaluation

<table>
<thead>
<tr>
<th>PROC</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 8b, 9, 10, 14, 19, 26</td>
<td>FFP1 mask</td>
<td>APF=4</td>
<td>gloves are optional for mechanical/heat protection where needed</td>
<td>standard working clothes (overall long sleeve) and safety shoes</td>
</tr>
<tr>
<td>8a</td>
<td>FFP2 mask</td>
<td>APF=10</td>
<td></td>
<td>antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/ dust explosion exists</td>
</tr>
<tr>
<td>7</td>
<td>FFP3 mask</td>
<td>APF=20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3, 13, 22, 23, 24, 25</td>
<td>not required</td>
<td>na</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 3. Exposure estimation and reference to its source

#### Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m$^3$.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.

#### Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
<th>PNECadd</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>5 000</td>
<td>g/T</td>
<td>Metal spERC: Formulation of metal compounds</td>
<td></td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>40</td>
<td>g/T</td>
<td>Metal spERC: Formulation of metal compounds</td>
<td></td>
</tr>
<tr>
<td>Tonnage</td>
<td>100</td>
<td>T Mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission days</td>
<td>190</td>
<td>days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compartment</td>
<td>PNECadd</td>
<td>RCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PECadd STP</td>
<td>0.66</td>
<td>mg/l</td>
<td>10.8</td>
<td>0.06</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>65.2</td>
<td>µg/l</td>
<td>410</td>
<td>0.16</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>42.3</td>
<td>mg/kg dw</td>
<td>268</td>
<td>0.16</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>30.8</td>
<td>mg/kg dw</td>
<td>268</td>
<td>0.12</td>
</tr>
<tr>
<td>PECadd,air (100 m)</td>
<td>3.0</td>
<td>ng/m$^3$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

**Occupational exposure**

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE ([www.ebrc.de/mease.html](http://www.ebrc.de/mease.html)) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

\[
\text{DNEL}_{\text{inhalation}}: 10 \text{ mg/m}^3
\]

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 "Generic exposure scenario approach" above.

**Environmental emissions**

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

The Metal EUSES calculator for DUs can be freely downloaded from [http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool](http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool). In the registrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

**Additional good practice advice (for environment) beyond the REACH CSA**

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 5: Use of massive metal (for Solid forming processes – incl. production of welding electrodes &)

### Exposure Scenario Format (1) addressing uses carried out by workers

<table>
<thead>
<tr>
<th>1. Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free short title</td>
</tr>
<tr>
<td>Systematic title based on use descriptor</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered</td>
</tr>
</tbody>
</table>

### 2. Operational conditions and risk management measures

#### 2.1 Contributing scenario (1) controlling environmental exposure

- **Name of contributing scenario:** Environmental exposure during use of massive metal in shaping

- **Further specification:**
  - ERCs covered in this scenario: ERC 12a
  - Instead of using the default ERC12a values from the ECHA guidance, spERCs based upon measured data are used.
  - Following sectors are covered by the spERC for use of massive metal in shaping:
    - Metal processing industry (extrusion, forging, wrought rolling, machining of semi-finished products)
    - Particulates production
    - Welding of Mg parts

- **Product characteristic:** Magnesium is used in massive form

- **Amounts used:** Amounts up to 6 000 ton Mg/year can be used at one site (highest value based on 2 questionnaires)

- **Frequency and duration of use/exposure:** Number of operating days: 250 (lowest value based on 2 questionnaires)

- **Environment factors not influenced by risk management:** A default dilution factor of 10 is taken into account for freshwater

- **Other given operational conditions affecting environmental exposure:** Use/shaping happens indoor.

- **Technical conditions and measures at process level (source) to prevent release:** None

- **Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil:** Different kinds of RMM to prevent releases to the environment are possible:
  - Water:
    - Chemical precipitation (most common)
    - Sedimentation
    - Filtration
    - Electrolysis (rare)
  - Air:
    - Fabric or bag filters
    - Wet scrubbers
    - Electrostatic precipitation
    - Ceramic filters
    - Dry or semi-dry scrubbers

  Emission factors are based on the metal spERCs:
  - The metal spERC for Use of massive metal v 1.2 has been used:
    - Release to water: 0.01 %
    - Release to air: 0.02 %
**Organizational measures to prevent/limit release from site**

No specific organizational measures were considered.

**Conditions and measures related to municipal sewage treatment plant**

A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required.

**Conditions and measures related to external treatment of waste for disposal**

Magnesium waste should be recycled as much as possible.

**Conditions and measures related to external recovery of waste**

None.

### 2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

**Name of contributing scenario**

Manufacture and industrial uses of magnesium metal massive.

**Further specification**

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25.

**Product characteristic**

This contributing scenario applies to all industrial uses of magnesium metal massive.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions.

For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water. Thus direct contact of magnesium powder with water has to be omitted.

Please note that magnesium massive metal is not classified.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

3. Exposure estimation and reference to its source

Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.

Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>100</td>
<td>g/T</td>
<td>Metal spERC: Use of massive metal</td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>200</td>
<td>g/T</td>
<td>Metal spERC: Use of massive metal</td>
</tr>
<tr>
<td>Tonnage</td>
<td>6,000</td>
<td>T Mg</td>
<td></td>
</tr>
<tr>
<td>Emission days</td>
<td>250</td>
<td>days</td>
<td></td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartment</th>
<th>PNECadd</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PECadd STP</td>
<td>0.60 mg/l</td>
<td>10.8</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>59.4 µg/l</td>
<td>410</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>38.6 mg/kg dw</td>
<td>268</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>28.5 mg/kg dw</td>
<td>268</td>
</tr>
<tr>
<td>PECadd_air (100 m)</td>
<td>914 ng/m³</td>
<td></td>
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</tbody>
</table>

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL_inhalation: 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 “Generic exposure scenario approach” above.
Environmental emissions

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

The Metal EUSES calculator for DUs can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. In the registrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 6: Industrial use of metal compounds

<table>
<thead>
<tr>
<th>Exposure Scenario Format (1) addressing uses carried out by workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Title</td>
</tr>
<tr>
<td>Free short title</td>
</tr>
<tr>
<td>Industrial use of metal compounds</td>
</tr>
<tr>
<td>Systematic title based on use descriptor</td>
</tr>
<tr>
<td>SU3, SU8, SU9, SU10, SU14, SU15, SU16, SU17, SU23</td>
</tr>
<tr>
<td>PC3, PC7, PC14, PC19, PC0 (pyrotechnic composition)</td>
</tr>
<tr>
<td>AC1, AC2, AC3, AC7 (appropriate PROCs and ERCs are given in Section 2 below)</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered are described in Section 2 below.</td>
</tr>
</tbody>
</table>

2. Operational conditions and risk management measures

2.1 Contributing scenario (1) controlling environmental exposure

Name of contributing scenario

1. Environmental exposure during industrial use of metal compounds

Further specification

ERCs covered in this scenario: 4-7

Instead of using the default ERC 4, 5, 6 and 6 values from the ECHA guidance, spERCs based upon measured data are used. Following sectors are covered by the spERC for industrial use of metal compounds:

- Metallurgical industry (steel desulphurization, cast iron, metal reduction/deoxidation, debismuthising of Pb)
- Use in hydrogen storage tanks

Product characteristic

Magnesium is used in powder, granule or grain form

Amounts used

Amounts up to 1 200 ton Mg/year can be used at one site

Frequency and duration of use/exposure

Number of operating days: 350 (value based on 1 questionnaire)

Environment factors not influenced by risk management

A specific dilution factor of 20 is needed for freshwater to obtain a high enough dilution.

Other given operational conditions affecting environmental exposure

Use happens indoor.

Technical conditions and measures at process level (source) to prevent release

None

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Different kinds of RMM to prevent releases to the environment are possible:

Water:
- Chemical precipitation
- Sedimentation
- Filtration
- Electrolysis

Air:
- Fabric or bag filters (most common)
- Wet scrubbers
- Electrostatic precipitation
- Ceramic filters
- Dry or demi-dry scrubbers

Emission factors are based on the metal spERCs:
The metal spERC for industrial use of metal compounds v 1.1 has been used:
Release to water: 0.6 %
Release to air: 0.1 %

Organizational measures to prevent/limit release from site

No specific organizational measures were considered.
Conditions and measures related to municipal sewage treatment plant

A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required.

Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible

Conditions and measures related to external recovery of waste

None

2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

Name of contributing scenario

Manufacture and industrial uses of magnesium metal massive

Further specification

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25

Product characteristic

This contributing scenario applies to all industrial uses of magnesium metal massive.

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted. Please note that magnesium massive metal is not classified.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes atend of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
### Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

#### 2.3 Contributing scenario (3) controlling worker exposure for the handling of low dusty magnesium metal powders

**Name of contributing scenario**

Manufacture and industrial uses of low dusty magnesium metal powders

**Further specification**

PROCs covered in this scenario: PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 21, 22, 23, 24, 25, 26

**Product characteristic**

This contributing scenario applies to all industrial uses of low dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention, the avoidance of the ignition of explosive atmospheres, and the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, thus direct contact of magnesium powder with water has to be omitted.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

**Conditions and measures related to personal protection, hygiene and health evaluation**

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

#### 2.4 Contributing scenario (4) controlling worker exposure for the handling of medium dusty magnesium metal powders

**Name of contributing scenario**

Manufacture and industrial uses of medium dusty magnesium metal powders
**Further specification**

**PROCs covered in this scenario:** PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

**Product characteristic**

This contributing scenario applies to all industrial uses of medium dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.

**Technical conditions and measures at process level (source) to prevent release**

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

**Technical conditions and measures to control dispersion from source towards the worker**

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

**Conditions and measures related to personal protection, hygiene and health evaluation**

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Respiratory protective equipment is only required if workers may be exposed to medium dusty magnesium metal powders during PROC 7. For such situations a mask offering an assigned protection factor of 4 (e.g. FFP1) is required. Gloves are optional for mechanical/heat protection where needed. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

### 2.5 Contributing scenario (5) controlling worker exposure for the handling of high dusty magnesium metal powders

**Name of contributing scenario**

Manufacture and industrial uses of high dusty magnesium metal powders

**Further specification**

**PROCs covered in this scenario:** PROCs 1, 2, 3, 4, 7, 8a, 8b, 9, 10, 13, 14, 19, 22, 23, 24, 25, 26

**Product characteristic**

This contributing scenario applies to all industrial uses of high dusty magnesium metal powders.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.
Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, thus direct contact of magnesium powder with water has to be omitted.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation

<table>
<thead>
<tr>
<th>PROC</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 8b, 9, 10, 14, 19, 26</td>
<td>FFP1 mask</td>
<td>APF=4</td>
<td></td>
<td>standard working clothes (overall long sleeve) and safety shoes</td>
</tr>
<tr>
<td>8a</td>
<td>FFP2 mask</td>
<td>APF=10</td>
<td></td>
<td>antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves</td>
</tr>
<tr>
<td>7</td>
<td>FFP3 mask</td>
<td>APF=20</td>
<td>gloves are optional for mechanical/heat protection where needed</td>
<td></td>
</tr>
<tr>
<td>1, 2, 3, 13, 22, 23, 24, 25</td>
<td>not required</td>
<td>na</td>
<td></td>
<td>workplaces where the risk of powder ignition/ dust explosion exists</td>
</tr>
</tbody>
</table>

Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

3. Exposure estimation and reference to its source

Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.
### Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>6 000</td>
<td>g/T</td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>1 000</td>
<td>g/T</td>
</tr>
<tr>
<td>Tonnage</td>
<td>1 200</td>
<td>T Mg</td>
</tr>
<tr>
<td>Emission days</td>
<td>350</td>
<td>days</td>
</tr>
<tr>
<td>Dilution factor</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartment</th>
<th>PNECadd</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PECadd STP</td>
<td>5.14</td>
<td>10.8</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>254.6</td>
<td>410</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>165.3</td>
<td>268</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>241.5</td>
<td>268</td>
</tr>
<tr>
<td>PECadd,air (100 m)</td>
<td>914</td>
<td></td>
</tr>
</tbody>
</table>

### Guidance to DU to evaluate whether he works inside the boundaries set by the ES

**Occupational exposure**

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL\_inhalation: 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 "Generic exposure scenario approach" above.

**Environmental emissions**

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

The Metal EUSES calculator for DUs can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. In the registrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OCs and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

**Additional good practice advice (for environment) beyond the REACH CSA**

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 7: Etching of magnesium dies

<table>
<thead>
<tr>
<th>Exposure Scenario Format (1) addressing uses carried out by workers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Title</strong></td>
</tr>
<tr>
<td>Free short title: Etching of magnesium dies</td>
</tr>
<tr>
<td>Systematic title based on use descriptor: SU3, SU8, SU9, SU10, SU14, SU15, SU16, SU17, SU23, PC3, PC7, PC14, PC19, PC0 (pyrotechnic composition), AC1, AC2, AC3, AC7 (appropriate PROCs and ERCs are given in Section 2 below)</td>
</tr>
<tr>
<td>Processes, tasks and/or activities covered: Processes, tasks and/or activities covered are described in Section 2 below.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>2. Operational conditions and risk management measures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Contributing scenario (1) controlling environmental exposure</strong></td>
</tr>
<tr>
<td>Name of contributing scenario: Environmental exposure during etching of magnesium dies</td>
</tr>
<tr>
<td>Further specification</td>
</tr>
<tr>
<td>ERCs covered in this scenario: ERC 12b</td>
</tr>
<tr>
<td>Instead of using the default ERC12b values from the ECHA guidance, measured data are used. Following sector is covered by sector specific data:</td>
</tr>
<tr>
<td>- Etching of magnesium dies</td>
</tr>
<tr>
<td>Product characteristic</td>
</tr>
<tr>
<td>Magnesium is used in massive form and etched away</td>
</tr>
<tr>
<td>Amounts used</td>
</tr>
<tr>
<td>Amounts used not relevant for this scenario but approximate 400 ton/year (value based on 1 questionnaire)</td>
</tr>
<tr>
<td>Frequency and duration of use/exposure</td>
</tr>
<tr>
<td>Release is mostly intermittent but can also happen continuously</td>
</tr>
<tr>
<td>Environment factors not influenced by risk management</td>
</tr>
<tr>
<td>A default dilution factor of 10 is taken into account for freshwater</td>
</tr>
<tr>
<td>Other given operational conditions affecting environmental exposure</td>
</tr>
<tr>
<td>Use happens in batches, batches are discharged between 1 time per month to 2 times per day.</td>
</tr>
<tr>
<td>Technical conditions and measures at process level (source) to prevent release</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</td>
</tr>
<tr>
<td>Different kinds of RMM to prevent releases to the environment are possible:</td>
</tr>
<tr>
<td>Water:</td>
</tr>
<tr>
<td>- Chemical precipitation</td>
</tr>
<tr>
<td>- Sedimentation</td>
</tr>
<tr>
<td>- Filtration</td>
</tr>
<tr>
<td>- Electrolysis (rare)</td>
</tr>
<tr>
<td>Air:</td>
</tr>
<tr>
<td>Not relevant, no releases to air.</td>
</tr>
<tr>
<td>Emissions are not expressed in emission factors. A batch is discharged once it contains too much magnesium, usually around 5kg per 120 l bath. Those baths are diluted with washing water or water from other processes before being discharged to a water treatment plant. Worst case would assume discharging batches twice a day so 10 kg Mg release per day.</td>
</tr>
<tr>
<td>Organizational measures to prevent/limit release from site</td>
</tr>
<tr>
<td>No specific organizational measures were considered.</td>
</tr>
<tr>
<td>Conditions and measures related to municipal sewage treatment plant</td>
</tr>
<tr>
<td>A default municipal STP has been taken into account with a removal efficiency for Mg of 50% (REACH Guidance R.7.13-2, Section 2.2.1: Adjusting multimedia fate models for metals). If no municipal STP is available an on-site treatment with at least the same efficiency is required</td>
</tr>
</tbody>
</table>
Conditions and measures related to external treatment of waste for disposal

Magnesium waste should be recycled as much as possible

Conditions and measures related to external recovery of waste

None

2.2 Contributing scenario (2) controlling worker exposure for the handling of magnesium metal massive

<table>
<thead>
<tr>
<th>Name of contributing scenario</th>
<th>Manufacture and industrial uses of magnesium metal massive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Further specification</strong></td>
<td>PROCs covered in this scenario: PROCs 1, 2, 3, 4, 8a, 8b, 9, 13, 14, 19, 21, 22, 23, 24, 25</td>
</tr>
<tr>
<td><strong>Product characteristic</strong></td>
<td>This contributing scenario applies to all industrial uses of magnesium metal massive.</td>
</tr>
<tr>
<td><strong>Amounts used</strong></td>
<td>The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.</td>
</tr>
<tr>
<td><strong>Frequency and duration of use/exposure</strong></td>
<td>The exposure duration is not restricted for all applicable processes in this scenario.</td>
</tr>
<tr>
<td><strong>Human factors not influenced by risk management</strong></td>
<td>The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m$^3$/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.</td>
</tr>
</tbody>
</table>

Other given operational conditions affecting workers exposure

Operational conditions like process temperature and process pressure have been considered on a worst case basis for occupational exposure assessment of the conducted processes and a safe use was demonstrated under these conditions. For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention, the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted. Please note that magnesium massive metal is not classified.

Technical conditions and measures at process level (source) to prevent release

Risk management measures at the process level (e.g. containment or segregation of the emission source) are not required in the applicable processes unless such requirements are inherently required by the selected process category (e.g. closed process for PROC 1-3).

Technical conditions and measures to control dispersion from source towards the worker

Further localised controls are not required for the conducted processes. The risk of dust explosion shall be considered if a local exhaust ventilation is used.

Organisational measures to prevent/limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes atend of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (overall long sleeve) and safety shoes are required for all processes for good occupational hygiene practice. Antistatic worker equipment including cotton overalls, antistatic safety shoes and gloves are required for workplaces where the risk of powder ignition/dust explosion exists. Respiratory protective equipment is not required. Gloves are optional for mechanical/heat protection where needed. Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.

3. Exposure estimation and reference to its source

Occupational exposure

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³.

Due to the negligible dermal absorption of magnesium metal and the non-existing dermal effects, the dermal route is not a relevant exposure path for magnesium metal and a dermal DNEL has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant process categories and physical forms. Thus, a safe use is demonstrated for all relevant process categories.

Environmental emissions

<table>
<thead>
<tr>
<th>Operational conditions</th>
<th>Value</th>
<th>Unit</th>
<th>PNECadd</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental release factor to aquatic</td>
<td>10</td>
<td>kg/d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental release factor to air</td>
<td>Not relevant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tonnage</td>
<td>Batch discharged 1/month till 2/day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dilution factor</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compartiment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PECadd STP</td>
<td>2.50</td>
<td>mg/l</td>
<td>10.8</td>
<td>0.23</td>
</tr>
<tr>
<td>PEClocal,add in aquatic pelagic (freshwater)</td>
<td>247.6</td>
<td>µg/l</td>
<td>410</td>
<td>0.60</td>
</tr>
<tr>
<td>PEClocal,add in sediment (freshwater)</td>
<td>160.7</td>
<td>mg/kg dw</td>
<td>268</td>
<td>0.60</td>
</tr>
<tr>
<td>PEClocal,add in soil</td>
<td>117.2</td>
<td>mg/kg dw</td>
<td>268</td>
<td>0.44</td>
</tr>
<tr>
<td>PECadd,air (100 m)</td>
<td>No emission to air</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL-inhalation: 10 mg/m³

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 “Generic exposure scenario approach” above.

Environmental emissions

If a DU has OC (operational conditions)/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

The Metal EUSES calculator for DUs can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. In the registrant-interface, the generic default OCs and RMMs can be entered.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc… It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.
Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH. Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
ES 8: Welding in industrial and/or professional settings (environmental and occupational exposure)

**Exposure Scenario Format (I) addressing uses carried out by workers**

<table>
<thead>
<tr>
<th>1. Title</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Free short title</strong></td>
</tr>
<tr>
<td><strong>Systematic title based on use descriptor</strong></td>
</tr>
<tr>
<td><strong>Processes, tasks and/or activities covered</strong></td>
</tr>
</tbody>
</table>

**Assessment Method**

The hazard potential associated with welding processes is driven by the diversity of exposures to different contaminants which may either be contained in the welding objects or in the welding consumables. In addition, these contaminants may be released as gas or coarse or fine dust particles depending on the specific welding process and materials used. This exposure scenario therefore aims at providing information on the risk management measures to be implemented to ensure safe welding instead of just focussing the safe handling of magnesium. A detailed catalogue of the required risk management measures depending on the welding process and materials used have been published by Eurometaux, Eurofer and the European Welding Association (2010). This exposure scenario makes use of this document as far as possible but reference is given to the original document for additional information. The exposure assessment itself has been made on an exemplary basis on worst case assumptions using the exposure modelling tool MEASE.

**2. Operational conditions and risk management measures**

<table>
<thead>
<tr>
<th>Task</th>
<th>Involved tasks</th>
<th>Involved PROCs</th>
<th>ERCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding in industrial and/or professional settings</td>
<td>handling of electrodes and metal objects, welding</td>
<td>21, 25</td>
<td>8c, 8f</td>
</tr>
</tbody>
</table>

**2.1 Control of workers exposure**

**Product characteristic**

During welding in industrial and/or professional settings, magnesium is in a molten/gaseous form with a high emission potential.

**Amounts used**

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario.

**Frequency and duration of use/exposure**

The exposure duration is not restricted for all applicable processes in this scenario.

**Human factors not influenced by risk management**

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

**Other given operational conditions affecting workers exposure**

Not considered relevant for occupational exposure assessment of the conducted processes.

**Technical conditions and measures at process level (source) to prevent release**

To be selected according to the EUROMETAUX / EUROFER / EWA catalogue of risk management measures (see below for an abbreviated version of this catalogue)

**Technical conditions and measures to control dispersion from source towards the worker**

To be selected according to the EUROMETAUX / EUROFER / EWA catalogue of risk management measures (see below for an abbreviated version of this catalogue)

**Organisational measures to prevent/limit releases, dispersion and exposure**

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking in the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.
Conditions and measures related to personal protection, hygiene and health evaluation

Standard working clothes (long-sleeve overall) and safety shoes are required for all processes for good occupational hygiene practice. Gloves are optional for process steps at ambient temperature, thermal protective gloves should be used for hot processes. Respiratory protective equipment has to be selected according to the EUROMETAUX / EUROFER / EWA catalogue of risk management measures (see below for an abbreviated version of this catalogue). Reference is given to the section “Selection of appropriate respiratory equipment” and BS EN 529:2005 for a more detailed description of the requirements of personal protective equipment.
<table>
<thead>
<tr>
<th>Class</th>
<th>Process (according to ISO 4063)</th>
<th>Base materials</th>
<th>Remarks</th>
<th>Ventilation / Extraction / Filtration</th>
<th>RPE DC&lt;15%</th>
<th>RPE DC&gt;15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>GTAW 141</td>
<td>All</td>
<td>Except Al</td>
<td>GV low</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td></td>
<td>SAW 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Autogenous 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAW 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESW / EGW 72/73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resistance 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stud welding 78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid state 521</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gases brazing 9</td>
<td>Except Cd-alloys</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>GTAW 141</td>
<td>Al</td>
<td>n.a.</td>
<td>GV medium</td>
<td>FFP2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MMAW 111</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FCAW 136/137</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GMAW 131/135</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Powder plasma arc 152</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>All processes class I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All processes class II</td>
<td>Painted / primed / oiled</td>
<td>No Pb containing primer</td>
<td>GV low</td>
<td>FFP2</td>
<td>TH2/P2 LDH2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>MMAW 111</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FCAW 136/137</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GMAW 131</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Powder plasma arc 152</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>All processes class I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All processes class II</td>
<td>Stainless, Ni-, Be- and V-alloys</td>
<td>n.a.</td>
<td>LEV high</td>
<td>TH3/P3 LDH3</td>
<td>TH3/P3 LDH3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>GMAW 131</td>
<td>Be- and V-alloys</td>
<td>n.a.</td>
<td>Reduce (negative) pressure area</td>
<td>TH3/P3 LDH3</td>
<td>TH3/P3 LDH3</td>
</tr>
<tr>
<td></td>
<td>Powder plasma arc 152</td>
<td></td>
<td></td>
<td>LEV low</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RMM catalogue (REACH and the welding of Metals and Alloys), full version available at:**

---

### Unconfined space (no segregation, separation)

- **Process:** GTAW 141, SAW 12, PAW 15, ESW / EGW 72/73, Resistance 2, Stud welding 78, Solid state 521, Gases brazing 9
- **Base materials:** All, Except Al, Except Cd-alloys
- **Remarks:** GV low, LEV low
- **Ventilation:** GV low, LEV low
- **RPE:** n.a., FFP2
- **RPE DC<15%:** n.a., FFP3
- **RPE DC>15%:** n.a., TH2/P2 LDH2

### Confined space

- **Process:** Laser welding 52, Laser cutting 84, Electron beam 51
- **Base materials:** All
- **Remarks:** Closed system, LEV high
- **Ventilation:** GV medium, LDH3
- **RPE:** n.a., LDH3

---

**Class:** I, II, III, IV, V, VI, VII, VIII

**Remarks:**
- **GV low:** General Ventilation
- **LEV low:** Local Exhaust Ventilation
- **LEV high:** Local Exhaust Ventilation
- **LEV medium:** Local Exhaust Ventilation
- **Reduce (negative) pressure area:** Reduce (negative) pressure area

**Equipment:**
- **RPE:** Respiratory Protection Equipment
- **FFP2:** FFP2 filtering half mask
- **FFP3:** FFP3 filtering full face mask
- **TH2/P2 LDH2:** TH2/P2 laser protective helmet
- **TH3/P3 LDH3:** TH3/P3 laser protective helmet
- **TH3/P3 LDH3:** TH3/P3 laser protective helmet
**Glossary**

**Class**: approximate ranking to mitigate risk by selecting process/material combinations with the lowest value. Identified collective and individual risk management measures shall be applied.

**DC**: Duty cycle expressed on 8 hours.

**General Ventilation (GV) Low**: With additional Local Exhaust Ventilation (LEV) and extracted air to the outside, the GV or LEV capacity may be reduced to 1/5 of the original requirement.

**General Ventilation (GV) Medium**: double compared to Low

**Reduced (negative) pressured Area**: A separate, ventilated area where reduced (negative) pressure, compared to the surrounded area, is maintained.

**Local Exhaust Ventilation (LEV) High**: extraction at source (includes table, hood, arm or torch extraction)

**Local Exhaust Ventilation (LEV) Low**: extraction at source (includes table, hood, arm or torch extraction)

**Local Exhaust Ventilation (LEV) Medium**: extraction at source (includes table, hood, arm or torch extraction)

**Confined space**: despite its name, is not necessarily small. Examples of confined spaces include ship, silos, utility vaults, tanks, etc.

**Improved helmet**: designed to avoid direct flow of welding fumes inside.

Reference is given to the original document available at for more information:


### 2.2 Control of environmental exposure

**Product characteristics**

Not relevant for exposure estimation.

**Amounts used**

Total amounts used are not relevant since the assessment is done based on concentrations in STPs.

**Frequency and duration of use**

Usually continuous use/release: 365 days/year (wide dispersive use)

**Environment factors not influenced by risk management**

Flow rate of receiving surface should be sufficiently high to dilute the effluent concentration of the STP below the PNEC for water and sediment.

**Other given operational conditions affecting environmental exposure**

Indoor or outdoor use is possible

There are no intended releases of magnesium to water. The non-intended releases are negligible and pose no threat to the environment.

**Conditions and measures related to municipal sewage treatment plant**

Presence of a municipal sewage treatment plant is assumed.

**Conditions and measures related to external treatment of waste for disposal**

Waste discharged on own internal or external waste dumps.

**Conditions and measures related to external recovery of waste**

Not relevant

### 3. Exposure estimation and reference to its source

**Occupational exposure**

The exposure estimation tool MEASE was used for the assessment of inhalation exposure. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for magnesium metal of 10 mg/m³. Due to the negligible dermal absorption of metallic magnesium, the dermal route is not a relevant exposure path for metallic magnesium and a DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.

The RCRs were calculated far below 1 for all relevant processes. Thus, a safe use is demonstrated for all relevant processes.

**Environmental emissions**

There are no intended releases of magnesium to water due to the professional use of magnesium coated welding electrodes. The non-intended releases are negligible and pose no threat to the environment.
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

**Occupational exposure**

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

DNEL\textsubscript{inhalation}: 10 mg/m\textsuperscript{3}

Further guidance on how to evaluate whether a DU works inside the boundaries set by the ES is provided in Section 1.1 "Generic exposure scenario approach" above.

**Environmental emissions**

There are no intended releases of magnesium to water due to the professional use of magnesium coated welding electrodes. The non-intended releases are negligible and pose no threat to the environment.
ES 9: Professional use of magnesium powder in signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination

Exposure Scenario Format (1) addressing uses carried out by workers

1. Title

| Free short title | Professional use of magnesium powder in signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination |
| Systematic title based on use descriptor | SU22 (Professional uses) (appropriate PROCs and ERCs are given in section 2 below) |
| Processes, tasks and/or activities covered | Processes, tasks and/or activities covered are described in Section 2 below. |
| Assessment Method | The assessment of inhalation and dermal exposure is based on the exposure estimation tool MEASE. The environmental assessment method is given in Section 2 below. |

2. Operational conditions and risk management measures

<table>
<thead>
<tr>
<th>Task</th>
<th>Involved tasks</th>
<th>Involved PROCs</th>
<th>Involved ERCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination, launching/impaction (It is explicitly noted, that any containing magnesium is completely transformed into magnesium oxide during burning/impaction. Exposure to magnesium is therefore excluded.)</td>
<td>0</td>
<td>8e</td>
</tr>
</tbody>
</table>

2.1 Control of workers exposure

Product characteristics

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with solid substances at ambient temperature the fugacity is based on the dustiness of that substance. Whereas in hot metal operations, fugacity is temperature based, taking into account the process temperature and the melting point of the substance. As a third group, high abrasive tasks are based on the level of abrasion instead of the substance intrinsic emission potential.

<table>
<thead>
<tr>
<th>Workplace</th>
<th>Used in preparation?</th>
<th>Content in preparation</th>
<th>Physical form</th>
<th>Emission potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not restricted (used in closed container)</td>
<td>closed massive container</td>
<td>very low</td>
<td></td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>Not restricted (used in closed container until impaction/burning, high dilution by ambient air after burning). It is explicitly noted, that any containing magnesium is completely transformed into magnesium oxide during burning. Exposure to magnesium is therefore excluded.</td>
<td>not relevant</td>
<td>high</td>
<td></td>
</tr>
</tbody>
</table>
### Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROC) is the main determinant of the process intrinsic emission potential.

### Frequency and duration of use/exposure

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration of exposure (per shift/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>480 minutes</td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>only short durations per day</td>
</tr>
</tbody>
</table>

### Human factors not influenced by risk management

The shift breathing volume during all process steps reflected in the PROCs is assumed to be 10 m$^3$/shift (8 hours).

### Other given operational conditions affecting workers exposure

<table>
<thead>
<tr>
<th>Task</th>
<th>Room volume</th>
<th>Outdoors or indoors?</th>
<th>Process temperature</th>
<th>Process pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not restricted</td>
<td>not restricted</td>
<td>Process temperature</td>
<td>Process pressure</td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not restricted</td>
<td>outdoor use</td>
<td>Process temperature</td>
<td>Process pressure</td>
</tr>
</tbody>
</table>

For workplaces for which the risk of dust ignition/explosion exists, parallel existing legislation and/or standards have to be considered (e.g. 1999/92/EC, EN14797 and EN13463). Technical and/or organisational measures shall be taken appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow such prevention,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

To account for the high flammability of magnesium powder, measures to prevent ignition (e.g. no open fire in workplace, avoidance of electro-static discharges) are to be taken. Additionally, magnesium powder is classified as being flammable in contact with water, Thus direct contact of magnesium powder with water has to be omitted.
### Technical conditions and measures at process level (source) to prevent release

<table>
<thead>
<tr>
<th>Task</th>
<th>Level of containment</th>
<th>Level of segregation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>not required</td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>not required</td>
</tr>
</tbody>
</table>

### Technical conditions and measures to control dispersion from source towards the worker

<table>
<thead>
<tr>
<th>Task</th>
<th>Level of separation</th>
<th>Type of ventilation</th>
<th>Efficiency of ventilation (according to MEASE)</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>not required</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>dilution ventilation</td>
<td>Because of the outdoor setting of this scenario and the safety distance during burning, it is assumed that any emitted magnesium is diluted to an extent which renders occupational exposure very low.</td>
<td>try to maintain a certain distance to the emerging fume and try not to stand upwind if possible, otherwise, try not to spend a long time in the emerging fume</td>
</tr>
</tbody>
</table>

### Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

### Conditions and measures related to personal protection, hygiene and health evaluation

<table>
<thead>
<tr>
<th>Task</th>
<th>Specification of respiratory protective equipment (RPE)</th>
<th>RPE efficiency (assigned protection factor, APF)</th>
<th>Specification of gloves</th>
<th>Further personal protective equipment (PPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>na</td>
<td>not required</td>
<td>standard working equipment (clothing and shoes), eye and ear protection should be worn as appropriate</td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signalling and simulation ammunition and illumination</td>
<td>not required</td>
<td>na</td>
<td>during the use of signal flares, signal rockets or marking ammunition, protective gloves should be worn as appropriate</td>
<td></td>
</tr>
</tbody>
</table>
2.2 Control of environmental exposure

No quantitative environmental exposure is performed for the professional use of magnesium powder in signal flares, signal rockets, marking ammunition and signaling and simulation ammunition and illumination. These products are predominantly used in open air at sea (>90%) and land (<10%). During use, all magnesium is completely burned and transformed into MgO, and the MgO emitted will be deposited in the marine water or on soil surface. Because of the limited total amount of Mg used for this application (<100 tons/year), the small amount of Mg per individual product (<50 g per product), the wide dispersive nature of this use, and the large natural background concentration of Mg in the receiving environmental compartments (3930 mg Mg/kg soil and 1290 mg Mg/l seawater, see section 9.16.1), it is concluded that this specific use results in negligible additional environmental exposure to Mg or MgO and therefore has no impact on the environment.

3. Exposure estimation and reference to its source

### Occupational exposure

The assessment of occupational exposure is based on MEASE. The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL (long-term, systemic effects) for magnesium of 10 mg/m$^3$. The dermal exposure estimates as given by MEASE were divided by a default body weight for workers of 70 kg to compare the values with the systemic dermal DNEL.

<table>
<thead>
<tr>
<th>Task</th>
<th>Method used for inhalation exposure assessment (refer to introduction)</th>
<th>Inhalation exposure estimate (RCR)</th>
<th>Method used for dermal exposure assessment (refer to introduction)</th>
<th>Dermal exposure estimate (RCR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling of signal flares, signal rockets, marking ammunition, signaling and simulation ammunition and illumination</td>
<td>MEASE</td>
<td>0.05 mg/m$^3$ (0.005)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of signal flares, signal rockets, marking ammunition, signaling and simulation ammunition and illumination</td>
<td>It is explicitly noted, that any containing magnesium is completely transformed into magnesium oxide during burning. Exposure to magnesium is therefore excluded.</td>
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</tr>
</tbody>
</table>

### Environmental emissions

No quantitative environmental exposure is performed for the professional use of magnesium powder in signal flares, signal rockets, marking ammunition and signaling and simulation ammunition and illumination. These products are predominantly used in open air at sea (>90%) and land (<10%). During use, all magnesium is completely burned and transformed into MgO, and the MgO emitted will be deposited in the marine water or on soil surface. Because of the limited total amount of Mg used for this application (<100 tons/year), the small amount of Mg per individual product (<50 g per product), the wide dispersive nature of this use, and the large natural background concentration of Mg in the receiving environmental compartments (3930 mg Mg/kg soil and 1290 mg Mg/l seawater, see section 9.16.1), it is concluded that this specific use results in negligible additional environmental exposure to Mg or MgO and therefore has no impact on the environment.
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

### Occupational exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The dustiness of the substance used can be determined according to the MEASE glossary.

| DNEL | 10 mg/m³ |

### Environmental emissions

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